SECTION 400—BITUMINOUS PAVEMENTS

SECTION 401—PLANT MIX PAVEMENTS—GENERAL

401.01 Description. These specifications include general requirements that are applicable to all types of bituminous pavements of the plant mix type.

This work shall consist of one or more courses of bituminous mixture constructed on the prepared foundation in accordance with these specifications and the specific requirements of the type under contract and in reasonably close conformance with the lines, grades, thicknesses, and typical cross sections shown on the plans or as directed.

MATERIALS

401.02 Composition of Mixtures. The bituminous plant mix shall be composed of a mixture of aggregate, filler if required, other materials when specified, and bituminous material. The several aggregate fractions shall be sized and combined in such proportions that the resulting bituminous mixture is in accordance with the job mix formula and the composition limits established in 402.04(b), 403.04(b), 404.02, or 406. The aggregate in the mixture shall be well graded from coarse to fine and shall meet the gradation requirements shown in the composition limits.

Bituminous pavement mixtures produced in accordance with 402 and 403 are designated as LV, MV, or HV. The crushed particle requirements are set out in the following table. The crushed particle requirements for other bituminous mixtures are set out in the applicable section.

CRUSHED PARTICLES, PERCENT, MINIMUM

	Base			Binder			Surface		
	LV	MV	HV	LV	MV	HV	LV	MV	HV
Two-Lane Roads	40	70	95	55	70	95	70	100	100
Four-Lane Roads	70	95	95	70	95	95	70	100	100
Roads With More Than Four Lanes	95	95	95	95	95	95	100	100	100

Approved coarse aggregate types for LV, MV and HV surface mixtures are shown in the following chart.

COARSE AGGREGATE TYPES FOR BITUMINOUS SURFACE MIXTURES

Coarse Aggregate Type	LV Mixture or Shoulder Mixture	MV Mixture	HV Mixture
Air-Cooled Blast Furnace Slag	Yes	Yes	Yes
Steel Furnace Slag	Yes	Yes	Yes
Sandstone	Yes	Yes	Yes
Crushed Dolomite	Yes	Yes	Note 1
Crushed Stone	Yes	No	No
Gravel	Yes	No	No

Note: 1. Dolomite may only be used when blended equally with slag or sandstone.

401.03 Job Mix Formula.

(a) Source of Materials. Detailed information pertaining to the bituminous mixtures for the project shall be furnished on forms provided by the Department. This information shall include the Contractor's name, mix producer, plant location, plant number, contract number, road number, and the District in which the contract is located. Additional information shall include: the aggregate and bitumen producers, production sites and plant numbers, type and gradation of aggregate, type of bitumen, and types of mixture.

(b) Job Mix Formula Requirements. A job mix formula for the bituminous mixture for the project will be issued as provided herein. No mixture shall be produced until the job mix formula has been signed by the Contractor. The job mix formula shall specify:

1. Contract specifications and section number
2. Type of bituminous mixture
3. Type, gradation, and ledges of aggregates
4. Percent manufactured fine aggregate, when required
5. Type and grade of bitumen
6. Percent of bitumen based on the total weight of mixture, exclusive of water or solvents

7. Percent of aggregate passing the 4.75 mm (No. 4) sieve based on the total weight of aggregate

8. The minimum and maximum mix temperature at the plant

(c) Changes in an Established Job Mix Formula. The job mix formula for each mixture will be in effect until modified. Any proposed change in the type, size, source of any aggregate, or in the grade of bitumen shall be submitted and, if approved, a new job mix formula will be issued, which will supersede or supplement the original.

(d) Control. The following provisions shall prevail in the administration of the job mix formula.

Variations from the job mix formula, as shown by the Engineer's plant analysis, will be permitted as shown in the following table:

VARIATION FROM THE JOB MIX FORMULA

Category	% Passing 4.75 mm (No. 4) Sieve	% Bitumen
Compliance[1]	±5.0	±0.5
Non-Compliance[2]	±5.1 & greater	±0.6 & greater

Notes: 1. Mixtures produced within this range meet the specifications.

2. Mixtures which are produced within this range will be designated as failing to meet specifications. Production shall be discontinued until the non-conformance has been corrected. One or any combination of such variation may be cause for ordering removal of the material and replacement with acceptable material with no additional payment. If additional testing concerning non-complying material in place is requested, the sampling shall be done by the Contractor, as directed by the Engineer, and the testing will be done by the Engineer. The results of the additional testing will be considered along with the original samples in making a final evaluation of the non-complying material. If the material is permitted to remain in place, there will be an appropriate adjustment in the contract price.

401.04 Approval of Materials. Control and approval procedures will be determined by the mixture designation, mixture number, purpose and quantity. Bituminous mixtures are identified by number and designated LV, MV, or HV in accordance with 401.02.

Conformance with composition limits and bitumen content shall be in accordance with ITM 571. Conformance with crushed particle content shall be in accordance with ITM 204. Conformance with specification requirements, continuous uniformity, and

proper workability of the mixture will determine the acceptance of the mixture. General problems or procedures which cause substandard mixture, regardless of whether such mixture was determined by randomly selected tests, shall be corrected. Segregated or flushed mixtures will not be permitted nor allowed to continue and, if placed, shall be removed when directed.

(a) HV Bituminous Mixtures. Contracts containing one HV pay item exceeding one lot for base, binder or surface mixtures placed on the mainline, widening, or shoulders shall be in accordance with 401, 402 and 403 as applicable and these provisions. Patching, wedge and level, approaches, widening of 0.9 m (3 ft) or less, shoulders on two lane roads, temporary runarounds, temporary crossovers, base 2, base 5C, binder 8C and sand surface mixtures shall not be included, except as otherwise noted.

1. Responsibilities. The Contractor shall be responsible for all aspects of process control of the work. The Engineer will be responsible for acceptance testing.

2. Lots. A lot is defined as 3600 Mg (4000 T) of base and binder mixtures or 2400 Mg (2500 T) of surface mixtures. The lots will be determined as follows.

a. Mixture. For acceptance of the gradation, bitumen content, range of bitumen, range of gradation, and crushed particle content of the mixtures, the lots will be determined from the weigh tickets for the trucks. A request in writing may be submitted to have any bituminous mixture item included in these provisions.

b. Density. For acceptance of the density of the mixtures, the lots will be converted into lengths to the nearest 0.3 m (1 ft) that 3600 Mg (4000 T) and 2400 Mg (2500 T) represents.

3. Weather Limitations. The weather limitations of 401.05 will apply However, bituminous mixtures other than bituminous surface 11, HV shall be placed when the ambient temperature and the temperature of the surface on which it is to be placed is 0þ C (32þ F) or above.

4. Bituminous Pavers. Bituminous pavers shall be in accordance with 401.08 except that forward speeds may exceed 15 m (50 ft) per minute provided that the mix texture is uniform.

5. Job Mix Formula. A job mix formula for each mixture to be supplied shall be submitted in writing. No mixtures will be accepted until the job mix formula has been approved. The job mix formula shall specify:

a. Bituminous mixture

b. Type and source of aggregates

c. Type and grade of bitumen

d. A single percentage of aggregate passing each required sieve based on the total weight of aggregate. Each value shall be to the nearest 0.1 percent. All values shall be within the applicable composition limits in accordance with 403.04(b)1, 403.04(b)2, or 403.04(b)3, except as follows:

Mixture	%Passing 4.75 mm (No. 4) Sieve
Base 5	20-35
Base 5D	30-45
Binder 8	25-40
Binder 9	30-45
Binder 11	35-50
Surface 8	33-48
Surface 9	42-57
Surface 11	52-67
Surface 12	65-80

e. A single percentage of crushed particles for each mixture. The value shall be to the nearest 1.0 percent. The value shall be within the applicable crushed particle requirement of 401.02.

f. A single percentage of bituminous material, based on the total weight of mixture. The value shall be to the nearest 0.1 percent. The value shall be within the applicable bitumen content limits in accordance with 403.04(b)1, 403.04(b)2, or 403.04(b)3.

6. Mix Design Criteria. The job mix formula shall be determined from a mix design for each mixture. The testing laboratory submitting the design shall be approved. Approval will be based on the review of the Asphalt Materials Reference Laboratory procedure and equipment inspection report. The laboratory shall have presented appropriate equipment for inspection and shall have satisfactorily addressed any significant deficiencies. The Marshall method of mix design, in accordance with the Asphalt Institute publication, Mix Design Methods for Asphalt Concrete (MS-2), will be required. However, the mixture for the Marshall specimens and maximum specific gravity mixture shall be aged by the following method:

a. Place the mixture on a shallow metal oven and and spread it to an even thickness of approximately 21.53 kg/m² (2000 g/ft²).

b. Place the mixture and pan in a forced draft oven for 4 h ± 5 min. at a temperature of 135þC ± 1þC (275þF ± 2þF) for mixtures using asphalt cement and at 110þC ± 1þC (230þF ± 2þF) for mixtures using asphalt emulsion.

c. Stir the mixture every hour.

The applicable AASHTO standard test method shall be used. The optimum bitumen content

shall be the bitumen content that produces 6.0 percent air voids for all mixtures except base 5D mixture, which shall be 4.0 percent air voids. The design shall have at least 3 points, including a minimum of one point above and one point below the optimum. The proposed job mix formula and all supportive data shall be submitted for approval on forms provided. Three specimens and an uncompacted mixture sample representing the proposed job mix formula shall be submitted to the District Materials and Tests at least 2 weeks prior to use. The amount of the uncompacted mixture shall be determined in accordance with AASHTO T 209. The 3 specimens shall meet the following criteria:

MIX CRITERIA	MIN.	MAX.
Compaction (No. of blows each side of specimen)	75	75
Stability	1200	---
Flow	6	16
Percent Air Voids	4.0	8.0
Percent Voids in Mineral Aggregate (VMA)		
9.5 mm (3/8") Nominal Maximum Particle Size	16	---
12.5 mm (1/2") Nominal Maximum Particle Size	15	---
19.0 mm (3/4") Nominal Maximum Particle Size	14	---
25.0 mm (1") Nominal Maximum Particle Size	13	---
Base 5D Mixture	12	---

* The nominal maximum particle size is the largest sieve size upon which any material will be permitted to be retained.
**The percent air voids for base 5D mixture shall be 3.0 to 5.0.

Each HV mixture shall be tested for moisture susceptibility in accordance with ASTM D 4867. The minimum tensile strength ratio shall be 70 percent. If the mixture is not in accordance with the minimum tensile strength ratio requirement, an approved anti-stripping additive shall be added. Such procedure shall be used to determine the dosage rate of the anti-stripping additive which is in accordance with the minimum tensile strength ratio requirement. All data shall be submitted with the mix design for approval.

If there is a change in the type or source of an aggregate, a new job mix formula and mix design, and moisture susceptibility test, if required, shall be submitted for approval. The new job mix formula shall be in accordance with the requirements for the initial job mix formula, except that 3 specimens and the uncompacted mixture sample representing the proposed job mix formula shall be submitted to the District Materials and Tests one week prior to use.

7. Adjustment Period. An adjustment period for each mixture will be allowed in which changes can be made in the job mix formula, if necessary. The adjustment period shall be from the beginning of production and extending until one lot has been produced. If a mixture requires a redesign or production of a mixture extends into the next construction season, another adjustment period will be allowed.

Changes in the job mix formula may be made on the 12.5 mm (1/2 inch), 4.75 mm (No. 4), 600 µm (No. 30), or 75 µm (No. 200) sieve. Adjustments will be allowed on two of these sieves within the following limits:

Sieve Size	Base and Binder	Surface
12.5 mm (1/2")	±5.0	±4.0
4.75 mm (No. 4)	±5.0	±4.0
600 µm (No. 30)	±3.0	±2.0
75 µm (No. 200)	±1.0	±0.5

The adjusted job mix formula shall not exceed the applicable composition limits in accordance with 401.04(a)5d. If adjustments are necessary, a revised job mix formula shall be submitted in writing for approval prior to the completion of the third sublot of the next lot after the adjustment period.

In the event the allowable changes in the job mix formula are not sufficient and the field compacted specimens in the third sublot of the adjustment period meet the VMA and void requirements of 401.04(a)6, then additional changes may be allowed. The 12.5 mm (1/2 in.), 4.75 mm (No. 4), 600 µm (No. 30), or 75 µm (No. 200) sieve may be changed to meet the production gradation provided the adjusted job mix formula does not exceed the applicable composition limits in accordance with 401.04(a)5d. If approved, the revised job mix formula shall apply to all subsequent lots after the adjustment period. If not approved, the allowable changes on two sieves as set out above may be made.

Payment with respect to range, gradation, bitumen content, and crushed particle content for mixture produced during the adjustment period will be 100 percent of the contract price provided the following criteria are met:

a. The range of gradation and range of bitumen content is within the tolerances of 401.04(a)10.

b. The gradation complies with a composition limit that exceeds the upper and lower limits of 401.04(a)5d by the tolerance of 401.04(a)10.

c. The bitumen content is within the tolerance of 401.04(a)10.

d. The crushed particle content is within the tolerance of 401.04(a)10.

Compliance with the bitumen content, crushed particle content, and gradation will be determined from the average values obtained from the extraction, crushed particle content, and gradation tests performed by the Engineer. Compliance with range will be determined from the extraction and gradation tests.

If the mixture does not meet the requirements, adjustment points will be assessed in accordance with 401.04(a)10. The points assessed for range, bitumen content and crushed particle content will be based on variations exceeding the tolerances. The points assessed for gradation will be based on variations from the tolerances as set out above. All mixtures produced after the adjustment period will be paid for in accordance with 401.04(a)10.

8. Process Control. Sampling and testing shall be performed by a technician who has been certified by the Chief of the Division of Materials and Tests. The certified technician shall be at the plant during production. However, personal emergencies may arise which preclude the technician from being at the plant. If such a case occurs, notification shall be provided which states the steps which shall be taken to replace the technician as soon as possible. Production may be permitted in the interim period provided the required tests are performed. All test results shall be readily available for inspection by the Engineer. The Contractor's process control shall provide the following minimum testing.

a. At least three Marshall specimens shall be compacted and analyzed. The maximum specific gravity shall be determined in accordance with 401.04(a)6 during the first and third sublots of the adjustment period,

and by the completion of the second and fourth sublots for each subsequent lot after the adjustment period for each mixture. The mixture for the Marshall specimens and the maximum specific gravity sample shall be aged using the same procedure required for the mix design. Marshall specimens shall be compacted at these temperatures. If the Contractor demonstrates that comparable test results may be obtained with a reduced aging time, this procedure will be considered. 75 blows from a Marshall hand-compaction hammer in accordance with AASHTO T 245 shall be applied. A mechanically operated hammer may be used provided it has been calibrated to give results which are comparable with the hand operated hammer for each mixture. The three specimens, the uncompacted mixture, and all data shall be provided.

The Marshall specimens and the uncompacted mixture shall be used to verify that the mixture is in accordance with the VMA and void requirements of 401.04(a)6. If the mixture is not in accordance with 401.04(a)6 by the completion of the third sublot of the adjustment period, production shall be discontinued. A new job mix formula, mix design, and moisture susceptibility test if necessary, will be required. If consecutive sets of Marshall specimens after the adjustment period are not in accordance with the VMA and void requirements of 401.04(a)6, production shall be discontinued. A new job mix formula, mix design and moisture susceptibility test if necessary, will be required.

b. The gradation of aggregates in the bituminous mixture shall be controlled by performing one gradation analysis on samples obtained as follows:

(1) As a hot bin sample from the batch plant in sublots 2 and 4.

(2) As a sample of the aggregate from the cold feed belt, using an approved method, or as a sample of the aggregate from each individual stockpile, if a drum plant is used, in sublots 2 and 4.

All test results or related calculations shall be recorded and submitted to the Engineer at the completion of each lot. Test results shall be plotted on control charts which will be supplied by the Engineer. Such control charts shall be maintained on an ongoing basis, and shall be given to the Engineer upon completion of the production of each mixture.

c. The moisture and bitumen content of the reclaimed asphalt pavement used in recycled mixtures shall be determined in the first sublot of each lot, and recorded and submitted to the Engineer upon completion of each test. The bitumen content test results shall be plotted on a control chart which will be supplied by the Engineer. Such control charts shall be maintained on an ongoing basis and shall be given to the Engineer upon

completion of the production of all recycled mixtures.

9. Acceptance of Mixtures. Acceptance of mixtures for bitumen content crushed particle content, and gradation will be determined on the basis of extraction, crushed particle content, and gradation tests performed by the Engineer. A sublot will be 900 Mg (1000 T) for base and binder mixtures and a sublot will be 600 Mg (625 T) for surface mixtures. One random sample shall be obtained from each sublot from the pavement. The average of the test results for the four samples shall meet the requirements of 401.04(a)10 for tolerances from the job mix formula for each sieve, crushed particle content, and the bitumen content. The average percent passing the maximum particle size shall meet the requirements of 402.04(b)1, 403.04(b)2, or 403.04(b)3. If the averages for the bitumen content, crushed particle content, and each sieve do not meet the requirements, adjustment points will be assessed in accordance with 401.04(a)10.

Acceptance of mixtures for range will be determined from the test results of the extraction and gradation tests from each lot. If the range does not meet the requirements, adjustment points will be assessed in accordance with 401.04(a)10.

If visual examination of the mixture reveals that the mixture in any truck is obviously contaminated, deficient in bitumen content or not thoroughly mixed, that mixture will be rejected.

After the adjustment period, test results will only be available to the Contractor upon completion of all tests for each lot. If the Contractor does not agree with the Engineer's test results, it may request in writing that additional tests be performed. The

written request shall indicate the Contractor's basis for appeal and include supporting test results. The request shall be made within 5 calendar days of receipt of the written results of the mixture tests for that lot. Upon receipt and approval of the request for additional testing, the Contractor shall take cores of at least 150 mm (6 in.) in diameter from the sublot. The number of cores taken shall be such that the combined weight of the appealed mixture shall meet the minimum weight requirements for a sample in accordance with ITM 571. The location of the cores will be determined by adding 0.3 m (1 ft) to the original randomly selected station and using the same transverse offset of the pavement sample. All test results of these cores will be averaged for acceptance of the lot. If the requirements are not met, adjustment points will be assessed in accordance with 401.04(a)10.

10. Adjustment Points per Lot for Mixture. When test results for the mixture furnished exceed the allowable tolerances, adjustment points will be assessed as follows:

ACCEPTANCE TOLERANCE (±)

Mixture	Number of Tests	Sieve Size						
		37.5 mm* (1 1/2 in)	25.0 mm* (1 in.)	19.0 mm* (3/4 in.)	12.5 mm (1/2 in.)	4.75 mm (No. 4)	600 µm (No. 30)	75 µm (No.200)
Base	1	---	---	---	10.0	10.0	6.0	2.0
	2	---	---	---	7.0	7.0	4.2	1.4
	3	---	---	---	5.8	5.8	3.5	1.2
	4	---	---	---	5.0	5.0	3.0	1.0
Binder	1	---	---	---	10.0	10.0	6.0	2.0
	2	---	---	---	7.0	7.0	4.2	1.4
	3	---	---	---	5.8	5.8	3.5	1.2
	4	---	---	---	5.0	5.0	3.0	1.0
Surface	1	---	---	---	8.0	8.0	4.0	1.0
	2	---	---	---	5.7	5.7	2.8	0.7
	3	---	---	---	4.6	4.6	2.3	0.6
	4	---	---	---	4.0	4.0	2.0	0.5
Adjustment Points ≤ 1.0		0.1	0.1	0.1	0.1	0.1	0.2	0.3
For each 0.1% out of tolerance > 1.0**		0.1	0.1	0.1	0.1	0.2	0.3	0.6

*The acceptance tolerance for this sieve shall be the applicable composition limits specified in 403.04(b)1, 403.04(b)2 or 403.04(b)3.
**Total adjustment points will be obtained by adding the amount of adjustment points calculated for one percent out of tolerance to the amount of adjustment points calculated for greater than one percent out of tolerance.

Bitumen Content	ACCEPTANCE TOLERANCE (±) % Bitumen - Number of Tests								Adjustment Points
	Base & Binder				Surface				
	1	2	3	4	1	2	3	4	
% Bit	0.7	0.5	0.4	0.3	0.7	0.5	0.4	0.3	2 (For each 0.1% out High) 4 (For each 0.1% out Low)

Sieve Size & Bitumen Content	ALLOWABLE RANGE Percentage Points			Adjustment (For each 0.1% out of range)
	Base	Binder	Surface	
12.5 mm (1/2 in.)	15.0	15.0	12.0	0.1
4.75 mm (No. 4)	15.0	15.0	12.0	0.1
600 þm (No. 30)	9.0	9.0	6.0	0.1
75 þm (No. 200)	3.0	3.0	1.5	0.1
% Bit.	1.0	1.0	1.0	1.0

	ALLOWABLE TOLERANCE (-) Percent	Adjustment Points (For each 0.1% out of tolerance)
	Base, Binder, & Surface	
Crushed Content	5.0	0.2

When a complete lot of mixture cannot be obtained, then the amount of mixture produced will be considered a lot. Acceptance tolerances for bitumen content and gradation will be as set out above for the number of tests performed. The acceptance tolerance for crushed particle content will be as set out above for the aggregate from the number of tests performed. The acceptance tolerance for range will be as set out above for lots of more than one test. The range of bitumen shall be the difference between the highest bitumen content and the lowest bitumen content in one lot. The range of gradation shall be the difference between the highest percent passing and the lowest percent passing each required sieve in one lot.

Single test values and mean values will be reported to the nearest 0.1 percent. When the figures to be dropped in rounding off are exactly one-half of unity in the decimal place to be retained, the value shall be rounded up or down to the nearest even number in the decimal place to be retained.

11. Compaction of Mixtures. Addition of an anti-stripping additive to the mixture, if required, and all required traffic control for coring shall be with no additional payment.

Acceptance of mixtures for compaction will be determined on the basis of density tests performed by the Engineer from each lot. The lots will be divided into sublots of 1600 m^2 (2,000 sq yd) each for the mainline and shoulders, and 400 m^2 (500 sq yd) each for widening. The target density shall be determined from a test strip in accordance with ITM 577. The target density shall not be less than 96 percent of the unit weight of the mixture at the optimum bitumen content determined from the mix design. A test strip having an acceptable target density shall be constructed for each mix design. A separate test strip will be required on each lay placed on the mainline and each lay placed on the shoulder. Approval of non-specified compaction equipment and methods in accordance with 401.12(c) will not apply; however, use of such equipment and methods is subject to its ability to obtain uniform density throughout the lift being compacted. The Engineer may determine the uniformity of compaction by taking cores. An additional test strip may be requested by the Contractor or Engineer.

Acceptance density tests will be performed by the Engineer on the mainline, widening and shoulders. Upon completion of compaction of each sublot, the density will be determined at a randomly selected site in the sublot using a nuclear test device in accordance with ITM 577. The density for each sublot will consist of the average of 5 tests taken at random sites. If an individual sublot falls below 98 percent of target density, another randomly selected site within the sublot will be tested. These 2 test results will be averaged for the sublot density. If the average density of the sublot is less than 95 percent of the target density, adjustment points will be assessed in accordance with 401.04(a)12 to the lot containing the sublot. The densities of the sublots will be averaged to determine the average density of the lot. If the average density of the lot is less than 98 percent of the target density, adjustment points will be assessed in accordance with 401.04(a)12.

No density tests will be required for mixtures controlled by these specifications that are placed on areas other than the mainline, widening, and shoulders. However, the compaction equipment and procedure shall be the same in these areas as was used on the mainline, widening, and shoulders or as required elsewhere herein, when not applicable.

If the Contractor does not agree with the Engineer's test results for a sublot below 95 percent of target density, a request may be submitted in writing that additional tests be performed. The written request shall indicate the Contractor's basis for appeal and include supporting test results. The request shall be made within 5 calendar days from receipt of the written results of the density tests for that lot. Upon receipt and approval of the written request for additional testing, the Contractor shall take one core of at least 150 mm (6 in.) in diameter from each of the two original randomly selected sites within 5 calendar days unless otherwise prevented by the specifications. All traffic control shall be supplied with no additional payment. If cores are taken, the test results of these cores will be averaged for the density of the sublot. If the minimum requirements for density of the sublot are not met, adjustment points will be assessed in accordance with 401.04(a)12 to the lot containing the sublot. The Engineer may, however, order removal and replacement of the sublot, and there will not be payment for the original material. The replacement mixture will be tested randomly and included in the average lot density.

If the Contractor does not agree with the Engineer's test results for the lot, a request may be submitted in writing that additional tests be performed. The written request shall indicate the Contractor's basis for appeal and include supporting test results. The request shall be made within 5 calendar days from receipt of the written results of the density tests for that lot. Upon receipt and approval of the written request for additional testing, the Contractor shall take one core of at least 150 mm (6 in.) in diameter from each sublot at the original randomly selected sites within 5 calendar days, unless otherwise prevented by the specifications. Sublots below 95 percent of target density that have been previously cored will not be recored. All traffic control shall be supplied with no additional payment. If cores are taken, the test results of these cores will be averaged for the density of the lot. If the minimum requirements for density of the lot are not met, adjustment points will be assessed in accordance with 401.04(a)12.

12. Adjustment Points per Lot for Density. When the density of the lot exceeds the allowable tolerances, the adjustment points will be assessed as follows:

AVERAGE LOT DENSITY (% of Target Density)	ADJUSTMENT POINTS
98.0 or HIGHER	0
97.9 to 96.0	0.5 points for each 0.1% below 98.0
95.9 or LOWER	10 points + 1.0 point for each 0.1% below 96.0

SUBLOT DENSITY	ADJUSTMENT POINTS (% of Target Density)
Below 95	0.1 points for each 0.1% below 95.0

When a complete lot of mixture cannot be obtained, then the amount of mixture produced will be considered a lot. Regardless of the size of the lot, there will be a minimum of 5 density tests performed for the lot. The adjustment points for this mixture will be as set out above.

Sublot density values and lot density values will be reported to the nearest 0.1 percent. When the figures to be dropped in rounding off are exactly 1/2 of unity in the decimal place to be retained, the value shall be rounded up or down to the nearest even number in the decimal place to be retained.

13. Basis of Payment. The accepted quantity of the mixtures will be determined as set out below.

Whenever a mixture does not conform to the requirements for acceptance in accordance with 401.04(a)9 and 401.04(a)11, payment will be made on an adjusted quantity in accordance with the following:

a. The adjustment points for each lot will be determined in accordance with 401.04(a)10 for the bitumen content, gradation, range of bitumen, range of gradation, and crushed particle content, and 401.04(a)12 for density. The adjusted lot quantity will be the lot quantity multiplied by a factor which is equal to 100 percent minus the total number of adjustment points accumulated for the lot.

b. In the event the total adjustment for a lot is greater than 15 points, the pavement will be evaluated to determine if it is acceptable. If the Contractor is not required to remove and replace the mixture, the quantity of the lot will be adjusted in accordance with 401.04(a)13a, or as determined. If the mixture is removed, no payment will be made for mixture which is removed.

(b) LV or MV Bituminous Mixtures. If a contract contains an HV mixture controlled by 401.04(a), any LV or MV mixture placed on the mainline, widening, or shoulders shall be in accordance with 401.04(a). Contracts containing no HV mixture

controlled by 401.04(a) but containing one LV or MV pay item exceeding one lot for base, binder, or surface mixture placed on the mainline, widening, or shoulders on 2 lane roads shall be in accordance with 401.04(a), except as follows:

1. Lots. The lots will be determined for acceptance of the bitumen content, gradation, range of bitumen, range of gradation, and crushed particle content only.

2. Weather Limitations. The weather limitations shall be in accordance with 401.05.

3. Mix Design Criteria. The optimum bitumen content shall be the bitumen content that produces 5.0 to 6.0 percent air voids for all mixtures except base 5D mixture.

4. Bituminous Pavers. Bituminous pavers shall be in accordance with 401.08.

5. Compaction of Mixtures. Compaction of mixtures shall be in accordance with 401.12.

6. Basis of Payment. The accepted quantity of the mixtures will be determined as set out below.

Whenever a mixture does not conform to the requirements for acceptance in accordance with 401.04(a)9, payment will be made on an adjusted quantity in accordance with the following:

a. The adjustment points for each lot will be determined in accordance with 401.04(a)10 for the bitumen content, gradation, range of bitumen, range of gradation, and crushed particle content. The adjusted lot quantity will be the lot quantity multiplied by a factor which is equal to 100 percent minus the total number of adjustment points accumulated for the lot.

b. If the total adjustment for a lot is greater than 15 points, the pavement will be evaluated to determine if it is acceptable. If the Contractor is not required to remove and replace the mixture, the quantity of the lot will be adjusted in accordance with 401.04(b)6a or as determined. If the mixture is removed, no payment will be made for mixture which is removed.

(c) Mixtures Not Controlled by 401.04(a) or 401.04(b). Mixtures shall be in accordance with 401, 402, 403, 404, and 406 as applicable and these provisions.

The Contractor shall provide a process control plan which includes:

1. Calibration of plant and certification of scales

2. Designation of person responsible for process control

3. Process control sampling and testing for each mixture in accordance with the following:

   a. For contract quantities of less than 450 Mg (500 T), no tests are required

   b. For contract quantities of 450 mg (500 T) or more, the following tests are required

      (1) One hot bin analysis for batch plants or one cold bin analysis for drum plants for quantities of more than 450 Mg (500 T) of mixture per calendar week.

      (2) One gradation of each size of aggregate for each 900 Mg (1000 T) of mixture with a minimum of one per calendar week and a maximum of one per calendar day.

4. Documentation of process control testing

The Engineer will provide the job mix formula, approval of material sources, approval of mixing plant, and approval of Contractor's process control plan. Sampling and testing of the individual materials and the final mixture may be done when and where deemed necessary.

CONSTRUCTION REQUIREMENTS

401.05 Weather Limitations. Bituminous mixtures shall not be placed on subgrade if the temperature of any part of the roadbed from the subgrade to 75 mm (3 in.) below the subgrade is 0þ C (32þ F) or below; nor on existing bituminous or concrete surface whose temperature is -4þ C (25þ F) or below; nor when the surface on which they are to be placed is wet; nor when other conditions are obviously unsuitable.

If bituminous mixtures of 50 mm (2 in.) thickness or greater are placed when the base or air temperature is 7þ C (45þ F) or below, compaction shall be controlled by density in accordance with 401.12(a) and 401.12(b). Cessation Tables published by the Department will be furnished as a guide to determine the time available to obtain density under varying base and mixture temperatures.

Bituminous mixtures of 25 mm (1 in.) but less than 50 mm (2 in.) in thickness shall not be placed when the ambient temperature is 7þ C (45þ F) or below; nor when the surface on which it is to be placed is 7þ C (45þ F) or below.

Bituminous mixtures less than 25 mm (1 in.) in thickness shall not be placed when the ambient temperature is below 16þ C (60þ F); nor when the surface on which it is to be placed is below 16þ C (60þ F).

If a bituminous pavement section, as set out in the typical sections, is not completed through the binder, or surface lays where no binder course is required, sealing shall be required unless otherwise specified. This sealing operation shall consist of Type 1 Seal as set out in 407.03 and 407.04, except the minimum 4þ C (40þ F) temperature requirement in 407.04 shall not apply. The type 1 sealing operation shall be performed with no additional payment. In order to limit this sealing operation to a minimum, the Contractor shall be subject to the following additional provisions:

(a) Materials that are placed using the cessation criteria [at 7þ C (45þ F) or below] shall be placed no farther than can be covered in one day's operation of placing the succeeding course.

(b) The Contractor shall be responsible for any damage on all partially completed sections of roadway.

(c) All partially completed bituminous sections of roadway that are 200 mm (8 in.) or less in thickness shall be proofrolled prior to the placement of additional materials the following spring. Proofrolling shall be accomplished in accordance with 203.26 and 401.09(d). The contact pressure shall be 483 to 552 kPa (70 to 80 psi). Soft yielding areas shall be removed and replaced with no additional payment.

401.06 Bituminous Mixing Plant.

(a) Requirements for all Plants.

1. Material Storage.

a. Aggregates. The plant storage area shall be well drained and sufficient in size to provide complete separation of the stockpiles, bins, or stalls containing each aggregate size and type for use. Stockpiles shall be arranged so that there shall be no contamination of sizes during charging of the plant feeders. Aggregates shall be kept separate until each size has been proportioned accurately by the cold material feeder for delivery into the drier. Only approved aggregates in storage at the mixing plant will be permitted for use in bituminous mixtures. However, aggregates stockpiled at the source may be approved, provided adequate control can be maintained.

b. Asphalt Cements. Bituminous material storage tanks shall have sufficient capacity to supply normal plant production for a minimum of 4 hours for each type or grade of asphalt cement specified for each contract. Each tank shall be equipped with an approved sampling valve. On horizontal storage tanks, the sampling valve shall be located in the end bulkhead at approximately 0.9 m (3 ft) from the bottom of the tank. Vertical tanks shall have the valve no less than 1 m (3 1/2 ft) from the bottom. The inlet of the sampling device shall extend at least 0.3 m (1 ft) into the tank. Each tank shall be equipped to heat the bituminous material to required temperatures with the heat under automatic control at all times. This may be accomplished with steam coils, electricity, hot oil, or other approved means. The flame shall not come in direct contact with the tank being heated.

A circulating system shall be provided. All line valves shall have clear and permanent markings to indicate the open and closed positions. The pipe which returns the circulated bituminous material to the storage tank shall have its point of discharge no higher than 0.9 m (3 ft) above the bottom of the tank. The entire storage, circulation, and delivery system shall be equipped to maintain a constant temperature of the bituminous materials.

c. Cut Back Asphalts, Asphalt Emulsions. The requirements set out in 401.06(a)1b above shall apply to the storage and handling system for these types of bituminous materials, except the heating requirements, may be modified or waived.

2. Rating. The bituminous mixing plant will be given an official rating which will designate the normal production ability in tons per hour. The rating will be made after an inspection of the plant. Subsequent evaluation indicates all necessary components have been included, each is in good repair and conforms with the specifications requirements, and all units are properly coordinated. The plant will be rated as having a production capacity of either 50, 75, or 100 Mg (60, 90, or 120 T) per hour. The minimum plant rating required for a project will be:

TOTAL CONTRACT MEGRAMS(TONS)	PLANT RATING Mg/Hour (Tons/Hour)
Less than 5500 (6000)	50 (60)
5500 to 9000 (6000 to 10,000)	75 (90)
More than 9000 (10,000)	100 (120)

3. Cold Aggregate Feeder. The number of compartments in the cold aggregate bin shall be equal to or greater than the number of individual materials to be used in the mixture. The plant shall be equipped with an approved mechanical means for individually proportioning and feeding each aggregate before delivery into the drier. The feeder or feeders may be reciprocating plate, apron, belt, vibrating, or other approved type. Additional means shall be provided whereby the total amount of aggregate being fed can be increased or decreased without changing the established proportions. When 2 or more separate feed systems are used, there shall be an interlocking device to control the total combined feed therefrom. All controls shall be positive to the extent that no maladjustment can occur during operation.

4. Drier. The plant shall include one or more driers which will agitate the aggregates continuously without excessive segregation during the heating and drying process. Driers shall be capable of production of quantities in excess of the minimum plant capacity rating within the specified temperature limits. The drier burner or burners shall be equipped with automatic temperature controls which include a continuous pilot light with electric ignition, flame failure safeguards, automatic proportioning of both fuel and air, and a continuously recording temperature control. If the automatic burner controls malfunction and cannot be repaired readily, manual operation will be permitted

to complete the production for that day if the mixture temperature is maintained within the required limits. However, the equipment shall be in proper working order before resuming operation on another day.

5. Dust Collector. The plant shall be equipped with a dust collector constructed to waste or return the material uniformly as directed.

The final dust collector shall comply with all applicable laws, ordinances, and regulations regarding emissions. In either a batch or a continuous type plant, the material returned shall be fed into the boot of the hot elevator at a uniform rate by an approved feeder during the period when a full stream of aggregate is being fed from the drier to the hot elevator. In a dryer-drum mixing system, the material returned shall be fed into the drum at the same location as the bitumen material, and only during the same time that bitumen is being introduced.

6. Screening Unit. A screening unit will be required for all plants, unless otherwise specified. The unit shall be capable of separating the dried aggregate into sizes required for the mixture at a rate necessary to equal or exceed the plant production capacity. The operation of the system shall meet requirements set out below. Any deviation shall be cause for not accepting the mixture until corrections have been made.

a. Combined coarse and fine aggregates delivered from the drier shall be separated by a series of screens and deposited into 3 or more separate bin compartments. One bin may be used when producing the surface sand mixture and 2 bins may be used when producing either surface 11 or 12 mixture.

b. The screening unit shall be arranged so the separated aggregate fractions will pass into the proper bin compartment uniformly without excessive segregation.

c. An enclosed chute shall be provided for transfer of oversized aggregate from the screen to an approved disposal area.

d. The screening unit shall be enclosed in tight housing to eliminate spillage of material and emission of dust during operation.

e. There shall be no aggregate particles larger than the maximum specified size for the mixture in any bin compartment from which material is being furnished. The screens shall be operated in such a manner that no bin compartment contains more than 5 percent of a larger size than will pass the screen controlling the maximum size of the aggregate in that bin.

f. The contents of bin compartment No. 2 shall have no more than 10 percent passing a 4.75 mm (No. 4) sieve. Contents of bin

compartments No. 3 and No. 4 shall have no more than 15 percent passing the controlling screens over bin compartments No. 2 and No. 3 respectively.

7. Thermometric Equipment. An armored indicating thermometer having a minimum range of 21þ C (70þ F) to 204þ C (400þ F), readable to 2þ C (5þ F), shall be fixed in the bituminous material feed line immediately adjacent to the charging valve of the mixer unit.

An armored thermometer or pyrometer having a minimum range of 21þ C (70þ F) to 204þ C (400þ F), readable to 2þ C (5þ F), shall be installed in each bituminous material storage tank to indicate the temperature. An automatic heat control system shall be provided that maintains a constant temperature in each storage tank in accordance with the temperature requirements in 402.04(d), 403.04(d), or 404.02.

A recording thermometer or pyrometer shall be installed in all plants to record continuously the temperature of the aggregates or mixture at the point of discharge from the drier. The recording thermometer or pyrometer shall be such that it functions with and actuates the required automatic burner controls. The thermocouple shall be properly installed at the drier discharge so the aggregate or mixture temperature is measured without any influence from the heat inside the drier. Each daily recording chart shall be kept intact at the plant site and shall be accessible at all times until the project is completed and accepted.

An indicating pyrometer or thermometer shall be located so that the plant operator can continuously observe the temperature of the fine aggregate in the No. 1 bin compartment. The thermocouple shall be located in the No. 1 bin so that the aggregate temperature is indicated immediately before the aggregate is withdrawn for use in the mixture.

All thermometric equipment shall be accurate and in good condition at all times during plant operation.

8. Truck Scales. The bituminous mixture shall be weighed on approved scales furnished by the Contractor or on public scales at the expense of the Contractor except, automatic printer systems may be used with the scale systems of automatic batching type plants in accordance with 401.06(b)4. Truck scales, batch scales, and automatic printer systems, when used together, shall be inspected and sealed as often as deemed necessary to assure their accuracy, but no less than once each calendar year. The seal of the Division of Weights and Measures showing the latest inspection date shall be affixed to the scales, or automatic printer system, in a conspicuous place, and the inspection certificate shall be kept available at the scales.

9. Hot Surge Bin. Hot surge bins may be used for temporary storage of hot asphalt mixtures subject to the following requirements:

a. Use of the surge bin is subject to satisfactory performance and shall not lessen the quality of the bituminous mixture.

b. Each surge bin shall be equipped with a low level indicator and cut-off system which stops the discharge of mix from the surge bin when the mix falls below the top of the discharge cone. The cut-off system may be automatic, or may be an audio alarm which will allow the operator to manually stop the flow of material.

c. The temperature of any mixture at the time of spreading shall be uniform and shall be no less than specified.

d. The surge bin shall be emptied at the end of operations each day.

e. When heat is applied to the material in the surge bin, the equipment shall be capable of heating the material uniformly.

f. The surge bin may be used as a hot storage bin when asphalt hardening due to storage does not exceed 10 percent of the original value of penetration determined on the asphalt prior to mixing. The amount of hardening due to storage will be determined by comparison tests on samples of the mixture taken after exit from the pugmill but before entry into the storage bin and samples taken after exit from the storage bin. Mixture samples shall be chilled immediately and maintained at a temperature below 0þ C (32þ F) until tested. Recovery of asphalt from the mixture shall be in accordance with AASHTO T 164 and T 170.

10. Safety Requirements. Adequate and safe stairways to the mixer platform and sampling points shall be provided, and guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Accessibility to the top of truck bodies shall be provided by a platform or other suitable device to enable the Engineer to obtain sampling and mixture temperature data. All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be guarded and protected. Ample and unobstructed space shall be provided on the mixing platform. A clear and unobstructed passage shall be maintained at all times in and around the truck loading areas. This area shall be kept free from drippings from the mixing platform.

11. Blank.

12. Plant Calibration. A plant inspection will be made annually, and after a plant is moved. After each inspection, and before any mixtures are produced, a plant calibration shall be made for each mixture to be produced. New calibration tests shall be made
930 when any of the following occur: a change in coarse aggregate source or type; a major change in coarse aggregate gradation; or a change in the bituminous plant screens.

The control settings for the aggregates and asphalt shall be based on the plant calibration. Adjustments in aggregate control settings may be made based on extraction tests. Major changes in aggregate control settings shall be verified by bin analysis tests. Batch and continuous plants shall have a hot bin analysis test performed and dryer-drum plants shall have a cold bin analysis test performed.

Calibration may be done whenever necessary. The Engineer shall be notified when the calibration tests are to be made. The calibration tests shall be available for review until final acceptance of the contract.

(b) Requirements for Batch Type Plants.

1. Dried Aggregate Storage Bin. This bin shall have 3 or more separate compartments for storage of the screened aggregate fractions to be combined for the mixture. Partitions shall be tight, and the arrangements such that there can be no spillage of aggregates from one compartment into another. Each bin compartment shall have an overflow outlet of sufficient size and be in the proper location to prevent back-up of material into the screening unit or other compartments. Each overflow outlet shall have a pipe or closed chute to convey any discharged material to an approved disposal area. Each bin compartment shall have a nonleaking, positive opening and closing type of discharge gate. Approved means for taking bin samples shall be provided in each compartment.

2. Weigh-Box or Hopper. The weigh-box, or hopper, shall be of sufficient size and design to receive and weigh the amount of aggregate for the batch from one or more of the dried aggregate bins by free fall, and without hand leveling. It shall be supported from an approved suspension hopper type dial scale system or load cells with digital readout and shall be free from contact with any other part of the plant structure that would interfere with accurate weighing. The discharge gate shall be non-leaking, positive in action, and provide rapid and even flow of the entire batch into the mixer. A dust cover or metal shroud encasing the mixing and batching area shall be provided.

3. Bituminous Material Control. The equipment used to measure the bituminous material for the mixture, either by weighing or metering, shall be accurate to ± 0.5 percent by weight.

The weigh bucket shall be a non-tilting type, having a capacity of at least 15 percent in excess of the weight required for the batch. An attached metal cover shall be required unless the bucket is completely within an enclosure at the mixing area. Steam or oil jackets, electric heat units, or other approved heating methods shall be used. Delivery of bituminous material into the mixer shall be distributed evenly over at least 3/4 of the length of the mixer and may be made directly from a heated spray bar of approved design. There shall be no leakage in the system. There shall be a heated, quick acting, non-drip, charging valve directly over the bucket. The bucket shall be supported by suspension type dial scales or load cells with digital readout in such manner that there is nothing interfering with the accuracy of the weighing.

The metering system shall consist of an indicating dial and control head mechanism, meter, manifold, automatically controlled valve, and non-drip type spray bar. The spray bar discharge shall extend over at least 3/4 of the length of the mixer. The indicating dial shall have a maximum capacity of at least 15 percent in excess of the quantity of bituminous material used in a batch. The dial shall be graduated in increments of 0.25 L (0.10 gal.). The control system shall operate in such a manner that

any required volume may be set on the dial and the dial locked. When delivery of the bituminous material is completed, the dial shall reset automatically to that reading. The flow of bituminous material shall be controlled to start automatically when the gate of the weigh box is closed after the aggregate has been discharged into the mixer or at the end of the dry mixing period, if one is required. The section of the line between the meter and the spray bar shall be provided with a valve and outlet for checking the meter delivery. The control head shall have an adjustment with a locking device to compensate for variation of delivery caused by change in viscosity of the bituminous material. The meter, spray bar, valves, piping, and other fittings used to control the flow of bituminous material shall be heated adequately in an approved manner.

4. Plant Scales. Scales shall be accurate to ±0.5 percent throughout their weight range. The batching scales for weighing the aggregate and bituminous material shall be suspension hopper type with springless dial heads or load cells with digital readout. The dial heads shall be equipped with movable pointers, affixed either inside or outside the sash, that can be set to indicate the amount or cumulative total of the materials being weighed for the mixture. The dials shall be set and the pointers arranged so there will be no distortion or parallax during weighing. The scale systems shall be approved and their installation shall be made so that vibration from plant operation will not affect their operation or accuracy. Scales shall be inspected and checked as often as necessary to assure their continued accuracy. At least ten 25 kg (50 lb) weights for testing the scales shall be available at the plant. The handling of weights and giving other assistance shall be provided as needed during scale tests. When the bituminous material control is by metering, there shall be provided an approved platform scale having a capacity of at least 15 percent in excess of batch requirements for use in checking the accuracy of the metering system when necessary.

The plant scale system may include an approved automatic printer system which will print the individual or accumulative weights of the materials in each batch, provided the printer system is used in conjunction with approved automatic batching and mixing control equipment. The print-out of the weight of each batch, and the total weight of all batches in a load shall be on one ticket which will be considered as the weigh ticket for the load. This system will be accepted in lieu of the truck scales in accordance with 401.06(a)8. If this system is used, random loads may be selected to be weighed on commercial scales as frequently as directed. However, on contracts of 4,500 Mg (5000 T) or more, a load selected at random will be checked during the first day of production, and as frequently thereafter as directed. The gross weight of the check load and tare weight of the truck over the same scale, and the net weight of the mixture shall be recorded on a weigh ticket which is attached to the print-out ticket and retained in the file of the Engineer. The net weight of mixture in the check load shall not vary from the total weight of mixture recorded on the print out ticket by more than 90.7 kg (200 lb) for loads up to 9070 kg (10 t); 136 kg (300 lb) for loads from 9070 kg to 13,600 kg (10 to 15 t); or 181 kg (400 lb) for loads over 13,600 kg (15 t).

5. Mixer. The batch mixer shall be a twin shaft pugmill type, jacketed, or having other adequate means for heating the shell, and shall produce a uniform mixture within the job mix tolerances. The mixing blades, or tips, shall be arranged for a

runaround method of mixing unless otherwise directed. Proper tip clearances shall be maintained to prevent accumulation of uncoated aggregates in the bottom of the mixer. The gate shall close tightly and not leak at any time. A cover, enclosure, or other means shall be provided to prevent emission of dust and other materials from the mixer during the mixing cycle. Adequate means shall be provided to vent the mixer properly.

The rated batch capacity in kilograms (lb) shall be determined by multiplying 100 times the net volume of the mixer in cubic meters (cubic ft) below the center of the mixer shafts. Production batches may range from 20 percent below to 15 percent above rated capacity, provided the quality of the mixture is not impaired.

The time of mixing of the wet mix shall be a minimum of 35 seconds for all mixtures, except sand surface which shall be a minimum of 70 seconds, or as otherwise directed to produce a satisfactory mixture. The wet mixing time shall begin at the time the asphalt begins to enter the mixer and continue until the timer opens the mixer gate to discharge the mixture. No dry mixing time will be required unless otherwise directed. The procedure and interval will be established.

6. Timing Device. The batch plant shall be equipped with a time locking device that will control the operations during the complete mixing cycle. It shall:

a. Lock the weigh box gate after the aggregate combination has been discharged into the mixer until the mixer gate closes at the completion of that cycle.

b. Lock the bituminous material bucket or volumetric control unit after delivery of the bituminous material into the mixer until the aggregates for the next batch are in the mixer.

c. Lock the mixer gate from the time of closing after dumping a mixed batch, until the end of the mixing time for the next batch.

A cumulative type batch counter shall be included in the time locking system. It shall be actuated by the locking of the bituminous control after the bituminous material has been delivered into the mixer. The setting of the timing intervals will be observed and done as directed. An automatic or semi-automatic cycling control may be used in lieu of the mechanical time lock if it is incorporated into an approved batching and cycling system that will comply with the requirements set out herein.

(c) Requirements for Continuous Mixing Plants.

1. Dried Aggregate Storage Bin. This bin shall have 3 or more separate compartments for storage of the screened aggregate fractions to be combined for the mixture. Partitions shall be tight, and the arrangements such that there can be no spillage of the aggregates from one bin compartment into another. Each bin compartment shall have an overflow outlet of sufficient size and be in the proper location to prevent back-up

of material into the screening unit or other compartments. Each overflow outlet shall have a pipe, or closed chute, to convey any discharged material to an approved disposal area.

Each compartment in the bin unit shall have a means for turning on a warning light, ringing a bell, or otherwise indicating when the material in the compartment approaches a low level. It shall also be provided with a low level control which will shut off the pugmill, bituminous material pump, and aggregate feeder automatically when the material in any compartment reaches such a low level. The shut off device shall be activated when the low level of the aggregate is not less than 300 mm (12 in.) above the top of the control gate for that compartment.

Each compartment shall have an accurately controlled individual gate, forming an adjustable rectangular orifice through which the aggregates shall be drawn for the mixture. The gate adjustment shall be by positive mechanical means which can be securely locked in position. Each gate shall have an indicator to show the respective opening in millimeters (in.) with graduations of not more than 6 mm (1/4 in.).

2. Aggregate Feeding and Proportioning Unit. There shall be a feeder, or feeders, directly under each bin compartment arranged so the exact amount of aggregate drawn therefrom may be determined accurately. All feeders shall be driven positively from one shaft, which shall be equipped with a cumulative counter having minimum graduated increments of 0.01 of a revolution and a capacity to include the daily total. The revolution counter shall be kept in good condition and be readily accessible for reading.

3. Weight Calibration of Aggregate Feed. The plant shall include a means for calibration of gate openings by weighing test samples. Provisions shall be made so that materials fed out of individual orifices may be bypassed to individual test boxes. The plant shall be equipped to conveniently handle individual test samples weighing not less than 91 kg (200 lb). If mineral filler is required in the mixture, an accurate fines feeder shall be provided which can be calibrated by weight, and which is interlocked with the bituminous material and aggregate feeders.

4. Bituminous Material Control. A positive displacement pump shall be furnished to deliver the bituminous material to the spray bar at the mixer. The pump shall be driven by positive means, and shall be interlocked with the aggregate feed and mixer drive. There shall be no bypass device between the pump and the spray bar, except a 3 way valve for circulation of the bituminous material when mixing is not in process will be permitted.

A meter shall be provided in the delivery line to the mixer. It shall be between the spray bar and the 3 way valve controlling the flow of bituminous material into the mixer. The meter shall have an indicator to show accurately and continuously, the rate of flow through the spray bar in liters (gal.) per minute. A set back type register shall be included to indicate the accumulated liters (gal.) of bituminous material that have been introduced into the mixture at any time during the production in any one day. The flow

of bituminous material shall be calibrated by drawing material from a line adjacent to the spray bar into a container and weighing the check sample, which shall weigh at least 91 kg (200 lb). The temperature of the bituminous material at the time of calibration shall be within ± 5þ C (± 10þ F) of that required at the time of use in the mixture.

5. Synchronization of Aggregate Feed and Bituminous Material Feed. Satisfactory means shall be provided to afford positive interlocking control between the flow of aggregates from the bins, and the flow of bituminous material from the meter or other proportioning device. An accurate platform scale, with a minimum capacity of 227 kg (500 lb), shall be provided for weighing the aggregate and bituminous material check samples. The scale shall be checked with test weights immediately before each calibration of the plant. The automatic shut off device in accordance with 401.06(c)1 shall also be activated by failure in the flow of bituminous material to the mixer, and shall stop the entire operation until the correction has been made.

6. Mixing Unit. The continuous mixer shall be a twin shaft pugmill type. It shall be jacketed for steam, hot oil, electric, or other approved method of heating. Mixing arm and paddles shall be adjustable and reversible. An adjustable dam gate shall be installed at the discharge end. A hinged cover shall extend the full length of the mixer. The manufacturer's plate shall be attached to the mixer. A chart shall be provided showing the net volumetric contents of the mixer at the several heights, inscribed on a permanent gage. An approved hopper shall extend from the discharge end of the mixer for collection of the finished mixture and for dumping it, without segregation, into the truck, in uniformly sized batches weighing a minimum of 1800 kg (4000 lb). The minimum mixing time shall be 45 seconds, which may be increased, if necessary, to produce a uniformly coated mixture.

7. Meters, Scales, and Other Measuring Devices. All meters, scales, and other measuring devices shall be accurate to within ± 0.5 percent throughout their range.

(d) Continuous Drum Type Mixing Plant. The continuous drum type mixing plant shall be in accordance with the applicable provisions of 401.06(a), except as follows.

1. Screens. A scalper, or other device, shall be provided in the cold feed delivery system to remove any oversize particles prior to the belt scales. Additional screens will not be required, provided the specified gradations and uniformity are maintained in the finished mixtures.

2. Cold Aggregate System. The number of compartments in the cold aggregate bin shall be equal to or greater than the number of stockpiles of individual materials to be used in an individual mixture. The compartments shall be of sufficient size to store the amount of aggregate required to keep the plant in continuous operation, and of proper design to prevent overflow of material of one compartment to that of another compartment. Compartments shall also be provided with a low level control which will automatically shut off the aggregate feeder, water and additive systems, bituminous material pump, and the drum, in proper sequence, or be provided with an

audible alarm system for the aggregate feed so that the operator can shut down the plant in proper sequence, when the material in any compartment reaches such a low level. The shut off device, or alarm system, shall be activated before the aggregate reaches the collector belt.

The feed system shall provide a uniform and continuous flow of aggregate in the desired proportion to the dryer. Each aggregate shall be proportioned from a separate compartment with individual proportional control and system total control.

The system shall provide positive weight measurement of the combined cold aggregate feed by use of belt scales or other approved devices. Provisions shall be made for calibration of the amount of aggregate delivered from each compartment, and the total amount of aggregate delivered from all compartments.

3. Bituminous Material Control. A positive displacement pump shall be used in an approved proportioning system to deliver the bituminous material to the injection line in the drum. This system must have a means of circulating the bituminous material when mixing is not in process. Also, a meter shall be provided in the delivery line to the drum. It shall be between the injection line and the 3 way valve controlling the flow of bituminous material into the mixer. The meter shall have an indicator to show accurately and continuously the rate of flow to the drum in liters (gallons) or kilograms (pounds) per minute. An accumulative type register shall be included to indicate the accumulated liters or kilograms (gallons or pounds) of bituminous material that have been introduced into the mixture at any time during the production in any one day. The flow of bituminous material shall be calibrated by drawing material from a line adjacent to the injection line into a container and weighing the check sample, which shall amount to at least 680 kg (1500 lb). The temperature of the bituminous material at the time of calibration shall be within the required working range of the temperature required at the time of use in the mixture.

4. Water and Additive Controls. Approved proportioning systems for additives shall be furnished when water and/or chemicals are to be added to promote adhesion and cohesion.

5. Synchronization of Aggregate Feed, Bituminous Material Feed, Water Feed, and Additive Feed. Satisfactory means shall be provided to afford a positive shut off or audible alarm control between the flow of aggregates from the bins, and the flow of bituminous material, and, if required, water and additive from the meters or other proportioning devices. The automatic shutoff device, or alarm system specified for the cold aggregate bin and feed system, shall also be activated by failure in the flow of bituminous material, water, or additive to the drum, and the entire operation shall be stopped until the correction has been made.

6. Dryer-Drum Mixing System. The dryer-drum mixing system shall be of a type that continually agitates the aggregate and asphalt mixture during heating and in which the temperature can be controlled so that aggregate and asphalt will not be injured in the necessary drying and heating operations required to obtain a well coated

mixture at the specified temperature. A continuous recording thermometer shall be provided which indicates the temperature of the mixture as it leaves the dryer-drum mixer.

The dryer-mixer may be fired from either inlet end or discharge end.

When the burner is fired into the discharge end of the dryer, the flights shall be such that a satisfactory mixture is produced. The flights shall also be arranged so that the mixture does not pass directly through the flame in the last 0.6 m to 2.4 m (2 to 8 ft) of the dryer. The bituminous material shall be introduced through a pipe equipped with a fan spray nozzle at a point from 1/3 to 1/2 of the dryer length from the discharge end of the dryer, approximately 0.3 m (1 ft) above the bottom of the dryer shell, or it shall be introduced at a point where proper mixing and operation of the plant are obtained.

When the burner is fired into the inlet end of the dryer, the flights shall be such that a satisfactory mix is produced. The flights shall extend from the inlet end through approximately 90 percent of the full length of the dryer. The bituminous material shall be introduced through a pipe equipped with a fan spray nozzle at a point 1/3 to 1/2 of the dryer length from the discharge end of the dryer, and approximately one foot above the bottom of the dryer shell, or it shall be introduced at a point where proper mixing and operation of the plant are obtained.

7. Hot Surge Bin. A hot surge bin, or bins, shall be a part of the system and shall be of such size and capacity to minimize production interruptions during the normal day's production. The bins shall be in accordance with 401.06(a)9, unless otherwise approved.

8. Emissions Controls. The plant shall be equipped to comply with all applicable laws, ordinances and regulations regarding emissions.

9. Meters, Scales, and Other Measuring Devices. All meters, scales, and other measuring devices shall be accurate to within ± 0.5 percent throughout their range.

401.07 Hauling Equipment. The mixtures shall be transported to the spreader in trucks that have tight, clean, smooth beds. Any type of truck may be used, provided satisfactory results are obtained.

(a) Truck Bed Cover. Each truck shall have a securely fastened, waterproof cover to adequately protect the mixture from the weather and foreign materials. The use of the truck bed cover shall be as directed.

(b) Anti-Adhesive Agent. A minimum amount of approved anti-adhesive agent, meeting the requirements of ITM 576, may be used to prevent mixtures from adhering to the beds. The Department's list of approved anti-adhesive agents may be obtained from the Contract Services Section. The truck bed shall be completely raised

after spraying when the anti-adhesive agent being used is fluid enough or applied heavy enough to flow in the truck bed. It shall remain in this position until the excess agent has been drained from the bed.

401.08 Bituminous Pavers. Bituminous pavers shall be selfcontained power propelled units, provided with an activated screed or strike-off assembly capable of being heated and capable of spreading and finishing courses of bituminous plant mix material in lane widths applicable to the typical sections and thicknesses shown on the plans. Extensions and extendable screeds will only be allowed if equivalent density is achieved behind the extensions and extendable screeds with no visible signs of segregation. The surface course for shoulders which are 2.4 m (8 ft) or more in width shall be placed with bituminous pavers. Bituminous pavers shall also be required for all width shoulders which are placed concurrent with pavement lanes. The activated heated screed paver will not be required for other shoulders and similar construction. However, pavers used for this construction shall be capable of spreading and finishing courses of bituminous plant mix material in widths shown on the plans.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.

The screed, or strike off assembly, shall produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

When laying mixtures, the paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture, but in no case shall the speed exceed 15 m (50 ft) per minute.

When the total contract quantity of bituminous mixture on a project exceeds 4500 Mg (5000 t), including the amount used in incidental construction, the paver or pavers used to place the mixture on the main traveled roadway or bituminous paved shoulders of 2.4 m (8 ft) or more in width, including the placing of wedge and leveling courses, shall be equipped with an approved automatic grade and slope control device. The use of this automatic device may be discontinued by written permission if it is determined that the vertical grade and alignment or surface conditions are such that, while using this device, a reasonably uniform bituminous thickness cannot be obtained. Automatic controls, however, will not be required when placing mixtures on approaches which are less than 61 m (200 ft) in length, or on miscellaneous work such as drives, mailbox approaches, crossovers, or temporary runarounds. This automatic control device shall isolate the screed action from the paver tracks or wheels. It shall also adjust both sides of the screed automatically to maintain a constant angle of attack in relation to the grade leveler device or grade line.

The operator's control panel shall be equipped with gages that indicate compliance to the established grade and slope. The panel shall also be equipped with the necessary controls to adjust the grade being laid to the grade leveler or previously laid course, and to adjust or vary the slope throughout the superelevated curves. The grade leveler shall

be used to activate the control device on each course, including matching lays. The length of the leveler shall be as directed, but in no case shall it be less than 9 m (30 ft) long. It shall be attached to the paver and shall operate parallel to the paver's line of travel. The grade leveler will not be required on surface courses 19 mm (3/4 in.) or less in thickness. When requested in writing and approved, the use of the leveler on other courses where its use is impractical is not required. A short shoe, or joint maker, may be permitted to activate the control device to construct the matching joint on the last course of surface mixture.

If so directed, wedge and leveling courses shall be constructed using a tight line set to a predetermined grade. The tension on the line shall be at least 36 kg (80 lb).

If the automatic control device should become inoperative, manual controls may be used to place bituminous mixtures which have been processed and are in transit to the site of the work.

All the necessary and approved, portable and small tools such as rakes, pouring pots, paint brushes, and brooms shall be provided and kept on hand. All shall be kept in first class condition. No container containing fuel oil or kerosene shall be hauled on the paver. Cleaning of tools using fuel oil or kerosene shall not be done over new or existing pavement. For checking purposes, a sufficient number of 3 m (10 ft) straight edges and cross templates shall be kept available. No paving shall be started prior to compliance with these provisions.

401.09 Rollers. Rollers shall be of the steel wheel and pneumatic tire type, and shall be in good condition, capable of reversing without backlash. They shall be operated at speeds not to exceed 4.5 km/h (3 mph) for static rollers and 4 km/h (2 1/2 mph) for vibratory rollers and slow enough to avoid displacement of the bituminous mixture. No container containing fuel oil or kerosene shall be hauled on any roller.

(a) Two Axle Tandem Rollers. Two axle tandem rollers used in this work shall be self-propelled; have 2 wheels; weigh no less than 9 Mg (10 tons); have all wheels equipped with scrapers which shall be used as needed to keep the surfaces clean; be equipped with devices to keep the wheels wet enough to prevent material sticking to them; be able to stop and start without jerking; have steering devices capable of easily and accurately guiding the roller along desired lines; and have devices to prevent oil, grease, or fuel from dropping onto the surface.

(b) Three Wheel Rollers. These rollers shall be in accordance with 401.09(a) except that they shall have 3 wheels; have a bearing on the road surface of no less than 5.3 kg/mm (300 lb/in) width of rear wheels; and have the wheels crowned no more than 63.5 mm (2 1/2 in.) in 5.5 m (18 ft).

Two axle tandem rollers which have a bearing on the road surface of no less than 5.3 kg/mm (300 lb/in.) width of the drive wheel may be used in lieu of the three wheel roller.

(c) Three Axle Tandem Rollers. These rollers shall be in accordance with 401.09(a) for 2 axle tandem rollers, except the roller shall weigh at least 13.5 Mg (15 t) and have 3 axles.

(d) Pneumatic Tire Rollers. These rollers shall be selfpropelled; have a minimum rolling width of 1676 mm (5 ft 6 in.); be equipped with wide tread compaction tires, minimum size 7:50 by 15; and be capable of exerting a uniform, average, contact pressure, as approved, from 345 kPa - 621 kPa (50 to 90 psi) uniformly over the surface by adjusting ballast and tire inflation pressure. The wheels on at least one axle shall be fully oscillating vertically, and so mounted as to prevent scuffing of the surface during rolling or turning. Wheels shall have provisions for wetting and cleaning the tires. Charts or tabulations showing the contact areas and pressures for the full range of tire inflation pressures and for the full range of tire loadings for each type and size of compactor used shall be furnished.

(e) Vibratory Rollers. Vibratory rollers shall be of the type that are specifically designed for the compaction of asphaltic concrete mixture. They shall be equipped with a variable amplitude system, a speed control device, and have a minimum vibration frequency of 2000 vibration per minute. A reed tachometer shall be provided for use in verifying the operating frequency.

(f) Trench Rollers. Trench rollers shall be self-propelled, produce a bearing on the bituminous surface of no less than 5.3 kg/mm (300 lb/in.) width of compacting wheel, and be in accordance with 401.09(a).

401.10 Conditioning of Existing Surface. When the surface of the existing pavement or old base is irregular, it shall be brought to uniform grade and cross section as directed.

When specified in the contract, all longitudinal and transverse joints and cracks shall be sealed by the application of an approved joint sealing compound before spreading the mixture upon a portland cement concrete surface. Excess bituminous material which can be removed with a sharp grader blade shall be removed from joints, cracks, and other areas prior to spreading the mixture.

Contact surfaces of curbing, gutters, manholes, and other structures shall be painted with a thin uniform coating of tack material prior to the bituminous mixture being placed against them.

Base, binder, and surface courses specified to be placed in lays of greater than 90 kg/m² (165 lb/sq yd) shall be brought up even with each adjacent lane at the end of each work day. Surface removal operations with an average thickness of greater than 40 mm (1 1/2 in.) shall be completed for the full width of the roadway by the end of each day.

The beginning and ending of each course shall,at the end of each day's operations, be feathered to provide a smooth transition to the driving surface.

401.11 Spreading and Finishing. The mixture shall be laid upon an approved surface; spread, and struck off to the grade and elevation established. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may

be practicable.

The longitudinal joint in one layer shall offset that in the layer immediately below it by approximately 150 mm (6 in.) when practicable. The longitudinal joints of the various layers below the surface shall not be offset by more than 0.3 m (1 ft) from the

centerline or lane lines. However, the joint in the top layer shall be at the centerline of the pavement if the roadway comprises 2 lanes of width or at lane lines if the roadway is more than 2 lanes in width.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked, and luted by hand tools. For such areas the mixture shall be dumped, spread, and screeded to give it the required compacted thickness.

Proper precautions shall be taken to prevent damage by construction operations to concrete edges adjacent to bituminous surfaces. These edges may be, but are not limited to, those above the compression seal at bridge expansion joint, those at overlay dams, front tops of gutters, front faces of curbs, and outside edges of aprons surrounding drainage grates. If damage occurs, repair shall be made with no additional payment.

Interstate route pavements and other divided lane pavements shall not be resurfaced where the vertical clearance under a structure is 4.9 m (16 ft) or less. Where such clearance is over 4.9 m (16 ft), the depth of resurface shall be limited to a thickness which will not reduce such clearance to less than 4.9 m (16 ft). Ramps which connect to the above type pavements shall provide the same clearance.

All other pavements shall not be resurfaced where the vertical clearance under a structure is 4.3 m (14 ft) or less. Where such clearance is over 4.3 m (14 ft), the depth of resurface shall be limited to a thickness which will not reduce such clearance to less than 4.3 m (14 ft).

The resurface shall be tapered to meet the grade of the pavement at a minimum of 30 m (100 ft) away from the structure. The taper rate of the resurface shall not exceed 0.17% (1 in. in 50 ft).

401.12 Compaction. Immediately after the bituminous mixture has been spread, struck off, and surface irregularities adjusted, it shall be compacted thoroughly by rolling. The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking, or shoving.

At least 3 rollers shall be operated with each spreader except as noted herein. Compaction, unless otherwise directed, shall be obtained with a 3 wheel roller in accordance with 401.09(b), followed with a pneumatic tire roller in accordance with 401.09(d) and the finish rolling shall be performed with a tandem roller in accordance with 401.09(a). The use of the pneumatic tire roller will not be required on any surface course less than 25 mm (1 in.) in depth or on total contract quantities on the project of 4500 Mg (5000 t) or less of mix, unless otherwise directed, but may be used as a third roller to comply with production requirements. If the pneumatic tire roller is not used on courses less than 55 kg/m^2 (100 lb/sq yd), the pass count for the 3 wheel roller will be 2 passes.

A roller pass is defined as being one complete coverage of a given area.

Compaction with the 3 wheel roller, pneumatic tire roller, and tandem roller shall be

option No. 1. The Contractor may elect not to use the 3 wheel roller or the pneumatic tire roller under option No. 2 or option No. 3 respectively. The minimum number of passes to be placed on bituminous courses shall be:

1470

	Courses 180 kg per m^2 (330 lbs./sq. yd. and less)			Courses more than 180 kg per m^2 (330 lbs./sq. yd)
	Option 1	Option 2	Option 3	
3 Wheel Roller	2	---	4	4
Pneumatic Tire Roller	2	4	---	4
Steel Wheel Tandem Roller	2	2	2	4

*The 3 wheel roller is required on all surface courses less than 55 kg/m^2 (100 pounds per square yard).

If detrimental results are being observed with the rollers, a reduced number of passes may be approved.

Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the road's centerline. On each trip, the heaviest roller wheel shall overlap its previous path by a minimum of 150 mm (6 in.). Rolling shall progress to the crown of the road. When paving in echelon or abutting a previously placed lane, the longitudinal joint should be rolled first followed by the regular rolling procedure. On super elevated curves, the rolling shall begin at the low side and progress to the high side by overlapping longitudinal trips parallel to the centerline.

When rolling adjacent lanes, the roller shall compress the joint by making the first pass to the paver with the roller on the hot material about 150 mm (6 in.) from the first placed lane. On the return pass, the first placed lane shall be overlapped about 150 mm (6 in.).

Rollers shall move at a slow but uniform speed with the drive roll or wheels nearest the paver. Rolling shall be continued until compaction is completed and all roller marks are eliminated.

Any displacement occurring as a result of reversing the direction of a roller, or from other causes, shall be corrected at once by the use of lutes and addition of fresh mixture when required. Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture.

To prevent adhesion of the mixture to the steel wheel rollers, the wheels shall be kept properly moistened with water, or water mixed with very small quantities of detergent, or other approved material. Excess liquid will not be permitted.

Along forms, curbs, headers, walls, and other places not accessible to the rollers, the mixture shall be compacted thoroughly with hand tampers, smoothing irons, or with mechanical tampers. A trench roller, in accordance with 401.09(f), may be used to obtain compaction in depressed areas.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with a fresh hot mixture, which shall be compacted with the surrounding area. Any area showing an excess or deficiency of bituminous material shall be removed and replaced.

All rolling operations shall be completed before the temperature of a HAC mixture drops below 80þ C (180þ F) or the temperature of a HAE mixture drops below 60þ C (145þ F). No mixture shall be dispatched from the plant so late in the day that it cannot be spread and compacted before sundown of that same day.

(a) Control of Compaction. When compaction is controlled by density, each course shall be compacted to a minimum of 98 percent of the target density. The target density shall be determined in accordance with 401.12(b). Density will be determined by means of a portable nuclear test device. If nuclear devices are not available, other approved methods may be used. Tests will be made at random locations as determined. If the average density of any area, after compaction, is less than 98 percent of the target density, the area shall be compacted further to a minimum of 98 percent of the target density. However, the additional compaction shall not continue to the point that detrimental results occur. If it is not possible to recompact the area to an average of 98 percent of the target density, the area will be acceptable if it has an average minimum density of 96 percent of target density. It is not the intent that such areas will be acceptable on a continuing basis. Should this occur in 2 areas in the production of any one day, an investigation of the cause will be made and it may be necessary to determine a new target density. If re-compaction of an area results in an average density less than 96 percent of target density, no subsequent courses shall be placed on the area until authorized.

(b) Construction of Test Strips and Determination of Target Density. When compaction of any course of bituminous mixtures is controlled by density, a test strip shall be constructed in accordance with ITM 577.

(c) Approval of Non-Specified Compaction Equipment and Methods. The use of roller types, sequence of roller operations, or the number of rollers, or any combination thereof which is other than specified may be approved. Approval of such alternate methods or equipment will not be given unless they produce densities equal to or greater than obtained by the use of the specified roller types and sequence. In order to evaluate the efficiency of the alternate methods or equipment, a test strip shall be constructed, and its mean density shall be compared to the mean density of a test strip constructed with the specified roller types and sequences. Procedures for the test strip shall be in accordance with 401.12(b). Generally, approval of alternate methods or equipment will not be granted for construction of wedge and level courses, bridge deck overlays, or courses less than 55 kg/m^2 (100 lb/sq yd).

Non-specified compaction equipment will be accepted as follows:

1. For courses of 55 kg/m^2 (100 lb/sq yd) to 180 kg/m^2 (330 lb/sq yd) will be accepted in accordance with the ITM 575

2. For courses greater than 180 kg/m^2 (330 lb/sq yd), the alternate methods or equipment will be approved if they produce densities equal to or greater than obtained from a test strip using the specified roller types and sequence in accordance with 401.12(b). Compaction will be controlled in accordance with 401.12(a)

401.13 Joints. Placing of the bituminous paving shall be as continuous as possible. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. When directed, a brush coat of bituminous material shall be

used on contact surfaces of transverse joints just before an additional mixture is placed against the previously rolled material.

401.14 Pavement Samples. When specified, samples shall be cut from the compacted pavement for testing. Samples of the mixture shall be taken for the full depth of the course at directed locations.

Where samples have been taken, new material shall be placed and compacted to conform with the surrounding area.

401.15 Pavement Smoothness. The profile shall be checked so that areas outside the allowable tolerances can be corrected by additional compaction. These areas may be heated by means of an approved infrared heater so further compaction is possible or so a portion of the material can be removed and recompacted. The mixture shall not be heated above 149þ C (300þ F). If it is determined necessary to remove and replace the materials in some areas to comply with these specifications, the material shall be removed to a depth as directed. The edges of the removal area shall be cut vertically by sawing along straight lines. These edges shall be tacked. Areas outside the allowable tolerances may be corrected by grinding with a grooved type cutter as used for correcting the profile of portland cement concrete. The use of a milling machine for correcting the profile will not be permitted. An alternate method for correcting the profile may be approved.

The pavement smoothness shall be checked by means of a profilograph, a 4.9 m (16 ft) long straightedge, or a 3 m (10 ft) long straightedge.

If a pay item, profilograph, is included in the contract, a Department approved profilograph shall be furnished, calibrated, and operated to record the surface profile of the finished pavement. The calibration and the operation of such machine shall be as directed and shall be in accordance with ITM 901. The profilogram produced shall become the property of the Department. The profilograph shall remain the property of the Contractor. When this work is not set out as a pay item, the testing machine will be furnished, calibrated, and operated by the Department.

The profilograph shall be used in areas having a design speed of greater than 70 km/h (45 mph), unless otherwise specified. The profilograph shall be used on all mainline full width pavement lanes of 76 m (250 ft) or longer and 180 kg/m^2 (330 lb/sq yd) or greater, including climbing lanes, and as otherwise specified.

The 4.9 m (16 ft) long straightedge shall be used in areas having a design speed of 70 km/h (45 mph) of lower, unless otherwise specified. The 4.9 m (16 ft) long straightedge shall be used on all mainline full width pavement lanes shorter than 76 m (250 ft), including climbing lanes. It shall also be used for ramps, tapers, frontage road, access road, and turn lanes. It shall be used within 15 m (50 ft) of bridge ends or within 15 m (50 ft) of an existing pavement which is being joined. It shall be used on resurface overlays of less than 180 kg/m^2 (330 lb/sq yd). The straightedge will not be required for single lay, non-milled work.

Pavement smoothness provisions shall not apply to single course overlays unless it is preceded by milling. All wavelike irregularities and abrupt changes in profile of single course nonmilled surface shall be corrected.

The 3.05 m (10 ft) long straightedge shall be used for transverse slopes, approaches, crossovers, and as otherwise specified.

Each finished course of base and binder shall be subject to approval. The profile shall be checked for all binder and surface courses. A binder course, as it applies to this specification, shall mean a new course placed immediately below the surface course. The profile shall be checked at a distance of 0.9 m (3 ft) from and parallel to the outside of each lane not exceeding 3.6 m (12 ft) wide. Lanes wider than 3.6 m (12 ft) shall be checked 0.9 m (3 ft) from and parallel to both edges. The profile index shall be the average of the 2 profiles. The contour shall be checked both transversely and longitudinally. Profile variation shall be corrected as described above to comply with these smoothness requirements. If grinding of bituminous mixtures under the surface course is approved for profile corrections to be in accordance with smoothness specifications, this grinding shall not precede the surface placement by more than 30 calendar days.

SURFACE TOLERANCES TABLE

Testing Method	Specified Tolerance
Profilograph	
Design speeds greater than 70 km/h (45 mph)	30 mm per 0.16 km profile index or less (1.2 in./0.1 mi)
Design speeds 70 km/h or less (45 mph)	41 mm per 0.16 km profile index or less (1.6 in./0.1 mi)
4.9 m (16 ft) Straightedge	
All pavements	6 mm (1/4 in.) or less
3 m (10 ft) Straightedge	
Base & Binders	6 mm (1/4 in.) or less
Surface	3 mm (1/8 in.) or less

Finishing equipment that produces a profile within the specified tolerances shall be used. If testing indicates that these tolerances are not being met, the paving operation shall be discontinued when directed until other methods and equipment are approved.

When the profilograph is being used on a surface course, in addition to the requirements for the profile index, all areas having a high point deviation in excess of 8 mm (0.3 in.) shall be removed. Verifying profilograph measurements will be taken only in the 161 m (0.1 mi) length where corrections have been performed to reduce the profile index.

When the profilograph is being used on a binder course, all areas having a high point deviation in excess of 8 mm (0.3 in.) shall be removed. When the 4.9 m (16 ft) or 3.0 m (10 ft) straightedge is being used on a binder course, all areas having a high point deviation in excess of 6 mm (1/4 in.) shall be removed.

401.16 Method of Measurement. Plant mix bituminous pavement and bituminous material will be measured by the megagram (ton) in accordance with 109.01(b) and 109.01(d) respectively. Batch weights will not be permitted as a method of measurement, unless the alternate provisions of 401.06(b)4 are met, then the cumulative weight of all the batches will be used for payment. When batch weights are used as the method of measurement for mixtures using asphalt emulsions, cumulative weights of asphalt shall be reduced by 30 percent to correct for the amount of water in the emulsion. The asphalt mass (weight) shall be that used in the accepted pavement and no deduction will be made for the mass (weight) of bituminous material in the mixture.

Due to possible variation in the specific gravity of the aggregates, the asphalt mass (weight) used may vary from the proposal quantities. No adjustment in contract unit price will be made because of such variation, except as provided in 904.02(a) for slag.

When specified in the Proposal book as a pay item, the quantity of bituminous material will be the number of megagrams (tons) used in the accepted work.

Checking of pavement smoothness will not be measured for payment.

401.17 Basis of Payment. All work performed and measured as prescribed above will be paid for as provided in the respective sections for each type specified.

Work performed in accordance with 401.10 will be paid for at the contract unit prices for the material used.

Necessary corrections for pavement smoothness will not be paid for directly, but will be included in the cost of the various bituminous mixture items. When the pavement smoothness is tested with the profilograph, the payment for pavement will be based on the profile index in accordance with the following table. The adjusted cost will be based on the total area of pavement represented by the profile index.

PRICE ADJUSTMENT SCHEDULE

Design Speed Greater Than 70 km/h (45 mph)		Design Speed Less Than Or Equal to 70 km/h (45 mph)	
Final Profile Index mm per 161 m (in./0.1 mi)	% of Contract Unit Price	Final Profile Index mm per 161 m (in./0.1 mi)	% of Contract Unit Price
0 to 30 mm (0.0 to 1.2)	100.0	0 to 41 mm (0.0 to 1.6)	100.0
over 30 mm to 33 mm (1.2 to 1.3)	98.0	over 41 mm to 46 mm (1.6 to 1.8)	98.0
over 33 mm to 36 mm (1.3 to 1.4)	96.0	over 46 mm to 51 mm (1.8 to 2.0)	96.0
over 36 mm to 38 mm (1.4 to 1.5)	92.0	over 51 mm to 56 mm (2.0 to 2.2)	92.0
All pavement with a profile index greater than 38 mm shall be corrected. (1.5)		All pavement with a profile index greater than 56 mm shall be corrected (2.2)	

This adjusted unit price will be applied using the planned applications to the total pavement placed including the aggregate base, the bituminous base, binder and surface. This cost reduction will include the total area of each 161 m (0.1 mi) long section represented by the profile index.

Payment for furnishing, calibrating, and operating the profilograph, and furnishing profile information will be made at the contract lump sum price for profilograph. This price will be full compensation regardless of how often the profilograph is used or how much profile information is furnished.

If dolomite is used as coarse aggregate in bituminous material in accordance with 401.02, payment will be based on the average elemental magnesium content. For full payment, the average elemental magnesium content of all acceptance samples shall be at least 10.3 percent. If the average elemental magnesium content is less than 10.3 percent, a price reduction shall be calculated using the equation as follows:

PR = 0.3 M D (10.3-A)
PR = Reduction of the contract unit price
M = Contract unit price
D = Dolomite coarse aggregate percent by weight of mix from job mix formula
A = Average elemental magnesium of acceptances samples

If the average elemental magnesium content is less than 8.3 percent, or if the elemental magnesium content of one or more individual acceptance samples falls below 6.6 percent, disposition of these materials shall be as directed by the Department's Failed Materials Committee.

If the Contractor disagrees with the test results, the Contractor may appeal based on the terms and conditions shown in ITM 205.

SECTION 402—HOT ASPHALT EMULSION PAVEMENT

402.01 Description. This work shall consist of constructing one or more courses of hot asphalt emulsion pavement as either a base, binder, wedge, leveling, or surface course in accordance with these specifications and in reasonably close conformance with lines, grades, amounts, and cross sections shown on the plans, or as directed.

MATERIALS

402.02 Aggregates. The aggregates shall be in accordance with the following:

Coarse Aggregates	904.02
For Base Mixtures-Class A, B, C, or D	
For Binder Mixtures-Class A, B, or C	
For Surface Mixtures-Class A or B	
Fine Aggregates (sand)	904.01

402.03 Bituminous Materials. The bituminous materials shall be in accordance with the following:

For Mixing and Patching, Asphalt Emulsion,AE-60	902.04
For Prime Coat,	
Asphalt Emulsion, AE-P	902.04
Cut-Back Asphalt, MC-70	902.03
For Tack Coat,	
Asphalt Emulsion, AE-T	902.04
Cut-Back Asphalt, RC-70	902.03

RC-70 may be used only during the months of November, December, January, February, and March.

402.04 Preparation of Mixtures.

(a) General. Mixtures shall consist of an intimate mixture of coarse aggregate, fine aggregate, and bituminous material combined in proportions within the limits set out in the following tables and as further fixed by the job mix formula. The mixture proportions have been prepared on the basis of using stone or gravel. When blast furnace slag is used, the bitumen content shall be adjusted to compensate for the specific gravity and surface area. When steel slag is used, the bitumen content shall be decreased to compensate for specific gravity and surface area.

When the use of one kind and size of aggregate is started, the use of that same kind and size shall be continued for the entire lift being constructed, unless otherwise permitted.

When a wedge or leveling course is required, base or binder mixture, as specified in 402.04(b)1 and 402.04(b)2, may be used in accordance with 403.09.

(b) Job Mix Formula and Composition of Mixtures. The job mix formula issued will be based on the limits shown in the following tables for the percent passing the 4.75 mm (No. 4) sieve and the percent of bitumen.

1. Composition Limits for Base Mixtures

Sieve Size	Percent of Aggregates Passing Sieves			
	Mixture			
	2	5	5C	5D*
63 mm (2 1/2 in.)	100			
37.5 mm (1 1/2 in.)	45-75	100	100	100
25.0 mm (1 in.)	30-60	80-99	70-98	80-99
19.0 mm (3/4 in.)	20-50	67-90	50-85	68-90
12.5 mm (1/2 in.)	15-40	42-74	28-62	54-76
9.5 mm (3/8 in.)	10-35	33-60	15-50	45-67
4.75 mm (No. 4)	15±5	30±5	15±5	40±5
2.36 mm (No. 8)	3-20	12-34	3-20	20-45
1.18 mm (No. 16)	2-15	7-28	2-15	12-36
600 þm (No. 30)	1-10	4-22	1-10	7-28
300 þm (No. 50)	0-7	1-16	0-7	3-18
150 þm (No. 100)	0-6	0-10	0-6	1-12
75 þm (No. 200)	0-4	0-4	0-4	0-5
Percent of Bitumen	2.5-3.5	4.0-5.1	3.0-4.5	4.0-5.1
Percent of Moisture, Max.	0.5	0.5	0.5	0.5

*Base 5D shall be used for the bottom layer of full depth bituminous pavement and may be used in the construction of shoulders, medians, or other areas not subject to traffic.

2. Composition Limits for Binder Mixtures

Sieve Size	Percent of Aggregates Passing Sieve Sizes			
	Mixture			
	8	8C	9	11
25.0 mm (1 in.)	100	100		
19.0 mm (3/4 in.)	80-98	70-98	100	
12.5 mm (1/2 in.)	56-80	40-68	70-92	100
9.5 mm (3/8 in.)	43-68	20-52	50-76	78-98
4.75 mm (No. 4)	35±5	15±5	40±5	45±5
2.36 mm (No. 8)	14-40	3-20	18-45	20-45
1.18 mm (No. 16)	8-32	2-15	10-36	11-36
600 þm (No. 30)	5-24	1-10	6-26	6-26
300 þm (No. 50)	2-18	0-7	2-18	2-18
150 þm (No. 100)	0-10	0-6	0-11	0-11
75 þm (No. 200)	0-4	0-4	0-4	0-4
Percent of Bitumen	4.1-5.2	3.0-4.5	4.3-5.4	4.5-5.6
Percent of Moisture, Max.	0.5	0.5	0.5	0.5

3. Composition Limits for Surface Mixtures.

Sieve Size	Percent of Aggregates Passing Sieves Size				
	Mixture				
	8	9	11	12	Sand*
25.0 mm (1 in.)	100				
19.0 mm (3/4 in.)	80-98	100			
12.5 mm (1/2 in.)	60-82	76-96	100	100	
9.5 mm (3/8 in.)	48-72	62-84	85-98	96-100	100
4.75 mm (No. 4)	43±5	52±5	62±5	75±5	95-100
2.36 mm (No. 8)	20-48	26-56	31-62	36-66	70-90
1.18 mm (No. 16)	12-38	14-46	17-50	19-50	40-68
600 µm (No. 30)	6-28	6-34	8-37	10-38	20-50
300 µm (No. 50)	2-20	2-22	3-25	5-26	7-30
150 µm (No. 100)	0-13	0-14	0-14	2-17	1-20
75 µm (No. 200)	0-4	0-4	0-4	0-5	0-5
Percent of Bitumen	4.7-6.0	5.0-6.4	5.5-7.0	5.7-7.2	7.0-8.0
Percent of Moisture, Max.	0.3	0.3	0.3	0.3	0.3

*The fineness modulus shall be greater than 2.80. A mix design in accordance with 401.04(a)6 shall be submitted except:

a. There will be no stability and flow requirements.

b. The mixture specimen shall be compacted at a temperature of 116 ± 3þ C (240 ± 5þ F)

c. The air voids shall be from 8 to 12 percent.

4. Additional Requirements. The percent of aggregates passing sieves specified in the composition of mixtures above is a percentage of the total weight of aggregates. The percent of bitumen specified in the composition of mixtures above is a percentage of the total weight of mixture, exclusive of water or solvent. The amount of moisture remaining in mixtures at the time of discharge from the mixer shall be as specified in the composition of mixtures above based on the weight of the test sample after drying.

5. Recycling. Recycling shall be in accordance with 403.04(b)6, except the asphalt shall be AE-60, AE-90 or AE-150.

(c) Preparation of Aggregates. The preparation of aggregates shall be in accordance with 403.04(c).

(d) Preparation of Bituminous Materials. The preparation of bituminous materials shall be in accordance with 403.04(d), except the temperature of the bituminous mixture shall not exceed 80þ C (180þ F) at the time of entering the mixer:

(e) Mixing with Emulsion. When producing hot asphalt emulsion mixtures in a batch plant, the emulsified asphalt shall be introduced into the pugmill at a rate not to exceed 3.6 kg/s/Mg (7.1 lb/s/t) of batch.

(f) Temperature Requirements for Mixtures. The temperature of the finished mixture at the plant shall be such that it produces a workable mixture when incorporated into the work, and shall comply with the following limits at the time of discharge from the mixer:

Base and Binder	100-115þ C (220-240þ F)
Surface, except Sand	100-130þ C (220-270þ F)
Sand Surface	110-150þ C (230-300þ F)
Sand Surface after September 15	130-150þ C (260-300þ F)

Note: The temperature of any mixture, at the time of spreading, shall be no lower than the lowest mixing temperature shown for that mixture in the table above, minus 10þ C (20þ F).

The minimum discharge temperature shall be increased, or other steps as necessary shall be taken to comply with the moisture requirements in the mixture as specified above.

CONSTRUCTION REQUIREMENTS

402.05 General Requirements. General requirements shall be in accordance with 401.05, 401.06, 401.07, 401.08, 401.09, 401.10, 401.11, 401.12, 401.13, 401.14, and 401.15.

402.06 Preparation of Subgrade or Base. This work shall be in accordance with 403.06.

402.07 Prime Coat. If the previously constructed course is granular and a prime coat is required, the work shall be done in accordance with 408.

402.08 Tack Coat. The tack coat on base or binder shall be in accordance with 409.

402.09 Spreading Mixture. The mixture shall be spread in accordance with applicable requirements of 403.09.

402.10 Compacting. Compacting shall be in accordance with 401.12, except compaction shall be completed before the temperature of the mixture has dropped below 60þ C (145þ F).

402.11 Protection of Bituminous Courses. Protection shall be in accordance with 403.11.

402.12 Method of Measurement. Hot asphalt emulsion pavement will be measured in accordance with 401.16.

402.13 Basis of Payment. The accepted quantities of hot asphalt emulsion pavement, including base, binder, surface, wedge, and leveling courses will be paid for at the contract price per megagram (ton) for the bituminous mixture complete in place.

Prime coat will be paid for in accordance with 408.10.

Tack coat will be paid for in accordance with 409.07.

Payment will be made under:

Pay Item	Metric Pay Unit Symbol (English Pay Unit Symbol)
Bituminous Base _____, _____ mixture LV, MV, or HV	Mg (TON)
Bituminous Binder _____, _____ mixture LV, MV, or HV	Mg (TON)
Bituminous Surface _____, _____ mixture LV, MV, or HV	Mg (TON)
Bituminous Base _____ HAE, _____ mixture LV, MV, or HV	Mg (TON)
Bituminous Binder _____ HAE, _____ mixture LV, MV, or HV	Mg (TON)
Bituminous Surface _____ HAE, _____ mixture LV, MV, or HV	Mg (TON)

If air cooled blast furnace slag is used in hot asphalt emulsion, or if steel slag is used in hot asphalt emulsion surface, the pay quantity will be adjusted in accordance with 904.02(a).

If the mixture is not specified on the plans, or in the Schedule of Pay Items, the mixtures for the specified pay item as set out herein may be used, except as restricted in 402.04(b).

If bituminous binder over bituminous base is specified, bituminous binder 8 will be permitted as a substitute for the bituminous binder and bituminous base upon receipt of a written request. The request for the change shall be prepared in advance of the work. A computation will be made in order to obtain a unit price for the bituminous binder 8. The quantity and contract unit price for bituminous binder 8 shall equal the sums of the quantities and contract unit prices for bituminous base and bituminous binder. The unit price for bituminous binder 8 shall be equal to the sum of the contract amounts divided by the sum of the contract quantities. Payment for the bituminous binder 8 will be made at the contract unit price per ton for bituminous binder 8. No payment will be made for additional work or costs which may result due to this change.

SECTION 403—HOT ASPHALT CONCRETE PAVEMENT

403.01 Description. This work shall consist of constructing one or more courses of hot asphalt concrete pavement as either a base, binder, wedge, leveling, or surface course, on a prepared base in accordance with these specifications and in reasonably close conformance with the lines, grades, thicknesses, and typical cross sections shown on the plans or as directed.

MATERIALS

403.02 Aggregates. The aggregates shall be in accordance with the following:

Coarse Aggregates	904.02
For Base Mixtures-Class A, B, C, or D	
For Binder Mixtures-Class A, B, or C	
For Surface Mixtures-Class A or B	
Fine Aggregates (sand, mineral filler)	904.01

403.03 Bituminous Materials. The bituminous materials shall be in accordance with the following:

Bituminous Materials for Mixture	
Petroleum Asphalt Cement	
AP-5, AP-4, AP-3	902.01
AC-20, AC-10	902.01
PG 64-22, PG 58-28	902.01
Bituminous Materials for Prime Coat	
Asphalt Emulsion AE-P	902.04
Cut-Back Asphalt MC-70	902.03
Bituminous Materials for Tack Coat	
Asphalt Emulsion AE-T	902.04
Cut-Back Asphalt, RC-70	902.03

RC-70 may be used only during the months of November, December, January, February, and March.

403.04 Preparation of Mixtures.

(a) General. Mixtures shall consist of an intimate mixture of coarse aggregate, fine aggregate including mineral filler if required, and asphalt cement combined within the limits in accordance with the following tables and as further fixed by the job mix formula. The mixture proportions have been prepared on the basis of using stone or gravel. When slag is used, the bitumen content will be adjusted to compensate for the specific gravity and surface area.

When the use of one kind and size of aggregate is started, the use of that same kind and size shall be continued for the entire lift being constructed, unless otherwise permitted.

When a wedge or leveling course, or both, is required, base or binder mixture as set out in 403.04(b)1 and 403.04(b)2 may be used in accordance with 403.09.

(b) Job Mix Formula and Composition of Mixtures. The job mix formula as issued will be based on the limits shown in the following tables for the percent passing the 4.75 mm (No. 4) sieve and the percent of bitumen.

1. Composition Limits for Base Mixtures.

Sieve Size	Percent of Aggregates Passing Sieves			
	Mixture			
	2	5	5C	5D*
63 mm (2 1/2 in.)	100			
37.5 mm (1 1/2 in.)	45-75	100	100	100
25.0 mm (1 in.)	30-60	80-99	70-98	80-99
19.0 mm (3/4 in.)	20-50	67-90	50-85	68-90
12.5 mm (1/2 in.)	15-40	42-74	28-62	54-76
9.5 mm (3/8 in.)	10-35	33-60	15-50	45-67
4.75 mm (No. 4)	15±5	30±5	15±5	40±5
2.36 mm (No. 8)	3-20	12-34	3-20	20-45
1.18 mm (No. 16)	2-15	7-28	2-15	12-36
600 µm (No. 30)	1-10	4-22	1-10	7-28
300 µm (No. 50)	0-7	1-16	0-7	3-18
150 µm (No. 100)	0-6	0-10	0-6	1-12
75 µm (No. 200)	0-4	0-4	0-4	0-5
Percent of Bitumen	2.5-3.5	4.0-5.1	3.0-4.5	4.0-5.1
Percent of Moisture, Max.	0.5	0.5	0.5	0.5

*Base 5D mixture shall be used for the bottom layer of full depth bituminous pavement and may be used in the construction of shoulders, medians, or other areas not subject to traffic.

2. Composition Limits for Binder Mixtures

Sieve Size	Percent of Aggregates Passing Sieves			
	Mixture			
	8	8C	9	11
90 25.0 mm (1 in.)	100	100		
19.0 mm (3/4 in.)	80-98	70-98	100	
12.5 mm (1/2 in.)	56-80	40-68	70-92	100
9.5 mm (3/8 in.)	43-68	20-52	50-75	78-98
4.75 mm (No. 4)	35±5	15±5	40±5	45±5
2.36 mm (No. 8)	14-40	3-20	18-45	20-45
1.18 mm (No. 16)	8-32	2-15	10-36	11-36
600 µm (No. 30)	5-24	1-10	6-26	6-26
300 µm (No. 50)	2-16	0-7	2-18	2-18
150 µm (No. 100)	0-10	0-6	0-11	0-11
100 75 µm (No. 200)	0-4	0-4	0-4	0-4
Percent of Bitumen	4.1-5.2	3.0-4.5	4.3-5.4	4.5-5.6
Percent of Moisture, Max.	0.5	0.5	0.5	.5

3. Composition Limits for Surface Mixtures.

Sieve Size	Percent of Aggregates Passing Sieves				
	Mixture				
	8	9	11	12	Sand*
25.0 mm (1 in.)	100				
19.0 mm (3/4 in.)	80-98	100			
12.5 mm (1/2 in.)	60-82	76-96	100	100	
9.5 mm (3/8 in.)	48-72	62-84	85-98	96-100	100
4.75 mm (No. 4)	43±5	52±5	62±5	75±5	95-100
2.36 mm (No. 8)	20-48	26-56	31-62	36-66	70-90
1.18 mm (No. 16)	12-38	14-46	17-50	19-50	40-68
600 µm (No. 30)	6-28	6-34	8-37	10-38	20-50
300 µm (No. 50)	2-20	2-22	3-25	5-26	7-30
150 µm (No. 100)	0-13	0-14	0-14	2-17	1-20
75 µm (No. 200)	0-4	0-4	0-4	0-5	0-5
Percent of Bitumen	4.7-6.0	5.0-6.4	5.5-7.0	5.7-7.2	7.0-8.0
Percent of Moisture, Max.	0.3	0.3	0.3	0.3	0.3

*The fineness modulus shall be greater than 2.80. A mix design in accordance with 401.04(a)6 shall be submitted. However, there will be no stability and flow requirements, and the air voids shall be 8 to 12 percent.

4. Composition Limits for Curb Mixtures.

Sieve Size	Percent of Aggregates Passing Sieves
12.5 mm (1/2 in.)	100
9.5 mm (3/8 in.)	90-99
4.75 mm (No. 4)	73±5
2.36 mm (No. 8)	45-77
1.18 mm (No. 16)	30-6
600 µm (No. 30)	17-47
300 µm (No. 50)	7-32
150 µm (No. 100)	4-17
75 µm (No. 200)	3-9
Minimum Percent Crushed	95
Percent of Bitumen	6.0-8.0

5. Additional Requirements. The percent of aggregates passing sieves specified in the composition of mixtures above is a percentage of the total weight of aggregates. The percent of bitumen specified in the composition of mixtures above is a percentage of the total weight of mixture exclusive of water or solvent. The amount of moisture remaining in mixtures at the time of discharge from the mixer shall be as specified in the composition of mixtures above based on the weight of the test sample after drying.

6. Recycling. Processed reclaimed asphalt pavement, asphalt roofing shingles, or a blend of both, from approved stockpiles may be used as a substitute for a portion of the new materials required to produce bituminous mixtures. Surface mixtures using reclaimed asphalt pavement, asphalt roofing shingles, or a blend of both shall be placed on the shoulders. The portion of reclaimed asphalt pavement, asphalt roofing shingles, or a blend of both used shall be as specified by the job mix formula. When the reclaimed asphalt pavement was obtained from the project for which the mixture is being produced, the portion of reclaimed asphalt pavement shall not exceed 50 percent. When the reclaimed asphalt pavement was obtained from sources other than the project for which the mixture is being produced, the portion of reclaimed asphalt pavement shall not exceed 20 percent. When both reclaimed asphalt pavement and asphalt roofing shingles are used in the same mixture, they shall be blended at a ratio of one part asphalt roofing shingles to four parts reclaimed asphalt pavement. The combined blend shall not exceed 20 percent by mass (weight) of the total mix. When only asphalt roofing shingles are used in the mixture, the shingles shall not exceed five percent by mass (weight) of the total mix.

The reclaimed asphalt pavement material shall be the product resulting from the cold milling or crushing of an existing bituminous pavement. The asphalt roofing shingles shall be waste from a shingle manufacturing facility. No tear-off material from roofs will be allowed.

Separate stockpiles for reclaimed asphalt pavement and asphalt roofing shingle materials shall be maintained. The stockpiles for reclaimed asphalt pavement shall be further maintained for each type by gradation, source of materials, and bitumen content. All of the reclaimed asphalt pavement in the proposed stockpile shall pass the 150 mm (6 in.) sieve. The reclaimed asphalt pavement shall be processed so that 100 percent will pass the 2 inch (50 mm) sieve when entering

the bituminous plant. The asphalt roofing shingles, if used, and the coarse aggregate in the reclaimed asphalt pavement shall pass the maximum size sieve for the mixture being produced. Quality control testing shall be conducted during the processing and stockpiling operation in accordance with the following schedule:

a. Stockpiles of 900 Mg (1,000 t) or less shall have a minimum of 2 complete bituminous mixture analyses. Also, a minimum of 2 penetration and 2 viscosity tests shall be performed on the recovered asphalt cement.

b. Stockpiles of more than 900 Mg (1,000 t) shall have one bituminous mixture analysis per 900 Mg (1,000 t) and a minimum of 3 analyses. Also, one penetration test and viscosity test shall be performed on recovered asphalt cement per 2,700 Mg (3,000 t). A minimum of 2 penetration and viscosity tests shall be performed per stockpile. Documented evidence of testing and accumulated tonnage shall be provided.

The asphalt cement shall be AC-2.5, AC-5, AC-10, AC-15, and AC-20, or PG 52-22, PG 58-22, PG 58-28 and PG 64-22.

The grade of asphalt cement shall be determined by blending the asphalt cement with the salvaged bitumen. The salvaged bitumen shall be obtained from the reclaimed asphalt pavement and from the asphalt roofing shingles, if used, by the Abson recovery method in accordance with AASHTO T 170. The proportions needed shall be based on the bituminous content of the recycled mixture. The combined bitumen blend shall have a minimum penetration of 50 and a viscosity of 2000 to 3000 poises.

A proposed job mix formula and a Marshall Mix Design in accordance with the requirements of 401.04(a)5 and 401.04(a)6 shall be furnished. If there is a change in the type or source of a material, a new job mix formula and mix design shall be submitted for approval. A minimum of 100 grams of the combined bitumen blend, a minimum of 50 grams of salvaged bitumen, and 0.9 L (1 qt) of asphalt cement shall be submitted in addition to the materials required by 401.04(a)6.

The bituminous mixing plant shall be in accordance with 401.06, modified for processing reclaimed asphalt pavement and asphalt roofing shingle materials. The plant and auxiliary equipment shall be approved prior to the start of production.

(c) Preparation of Aggregates. The coarse and fine aggregates shall be delivered from the mechanical feeder to the drier at a rate that ensures a uniform temperature control of the heating and drying operations. All aggregates shall be sufficiently dried so no foaming, flushing, or slumping occurs in the mix. The dried aggregates shall be screened into sizes that can be recombined to meet the mixture requirements and stored separately in accordance with 401.06(b)1 and 401.06(c)1, except when producing mixtures in a continuous drum type mixing plant.

(d) Preparation of Bituminous Materials. Flushing or blending of asphalt on the project will not be permitted. No asphalt shall be used while foaming. The bituminous material shall enter the mixer at a temperature which produces a suitable and workable mixture, but in no case at more than 165þ C (325þ F) for AP, AC, or PG grades. Bituminous materials which are reheated at the mixing plant to a temperature exceeding 165þ C (325þ F) for AP, AC or PG grades will be rejected.

(e) Temperature Requirements for Mixtures. The temperature of the finished mixture at the plant shall produce a workable mixture when incorporated into the work and shall be in accordance with the following limits at the time of discharge from the mixer:

ASPHALT IN MIXTURE	TEMPERATURE RANGES, þC (þF)	
	Minimum	Maximum
AP-5	125þ (260þ)	150þ (300þ)
AP-4	120þ (250þ)	140þ (285þ)
AP-3	120þ (245þ)	135þ (270þ)
AC-20	125þ (260þ)	150þ (300þ)
AC-15	120þ (250þ)	140þ (285þ)
AC-10	120þ (245þ)	135þ (280þ)
PG 64-22	125þ (260þ)	150þ (300þ)
PG 58-28	118þ (245þ)	138þ (280þ)

The temperature of any mixture, at the time of spreading, shall be no lower than the lowest mixing temperature shown for that mixture in the table above, minus 10þ C (20þ F).

CONSTRUCTION REQUIREMENTS

403.05 General Requirements. General requirements shall be in accordance with 401.05, 401.06, 401.07, 401.08, 401.09, 401.10, 401.11, 401.12, 401.13, 401.14, and 401.15, except as otherwise noted.

403.06 Preparation of Subgrade or Base. Mixtures for base may be placed on an earth subgrade, on an existing pavement surface to be used as a base, or on a previously prepared base or subbase as specified, and shall conform to the lines, grades, and cross sections shown on the plans or as otherwise specified. If such material is to be laid on a newly prepared subgrade, then all applicable provisions of 207 shall be met.

Just prior to placing the initial hot asphalt base course, the area on which it is to be placed shall be proof rolled with a pneumatic tire roller in accordance with 401.09(d). Proof rolling will not be required on resurfacing or widening of existing pavements, and in areas inaccessible to the roller. Proofrolling shall consist of a minimum of 2 complete coverages, or as directed. Any roller marks, irregularities, or failures shall be corrected as directed.

403.07 Prime Coat. If the previously constructed course is granular and a prime is required, priming shall be in accordance with applicable provisions of 408.

403.08 Tack Coat. The tack coat on base or binder shall be in accordance with 409.

403.09 Spreading Mixtures. Any surface on which a mixture is spread shall be free from objectionable or foreign material at the time of spreading. Base, binder, wedge, and leveling courses shall be allowed to cure before being subjected to traffic or before a
280 subsequent course is placed thereon. The time of curing shall be as directed. All surface courses shall be spread to such a thickness that, after compaction is completed, the surface will be approximately 6 mm (1/4 in.) above forms, gutters, or similar construction, in order to facilitate drainage.

If the required finished depth of any course is to exceed 3 times the maximum size of the aggregate used as shown by actual screen analysis, the course shall be constructed in 2 or more lifts as directed. The minimum finished depth of any course shall be 1 1/2 times the maximum size of the aggregate used as shown by actual screen analysis, except when used for wedge and leveling courses, scratch courses, or any areas involving feathering.

290

Except as otherwise permitted, lays shall be brought forward concurrently, within all practicable limits, limiting the laying progress in one lane to not more than one day's run before moving back to bring forward the adjacent lane. Lays of mixtures 2, 5C, or 8C shall be placed such that they may be covered in one day's operation of placement of the succeeding course.

For hot asphalt concrete binder, the use of mixture 5 will be permitted, if the course is of sufficient depth, in lieu of using mixture 8, 9, or 11. Regardless of the size of mixture selected or used, if so directed, the portion of binder to be placed as wedge and leveling, for
300 approaches, and for any areas involving feathering shall be mixture 9 or 11.

If the Schedule of Pay Items contains a pay item for hot asphalt concrete base but does not contain a pay item for hot asphalt concrete binder, it may be directed that binder 9 or 11 be placed as wedge and leveling courses, for approaches, and for any areas involving feathering. This binder will be paid for at the contract unit price for hot asphalt concrete base.

At locations where it is impractical to use conventional mechanical methods, other acceptable mechanical methods or acceptable hand methods may be used for placing and spreading.

310

403.10 Compacting. Compacting shall be in accordance with 401.12. However, compaction shall be completed before the temperature of the mixture has dropped below 80þ C (180þ F).

403.11 Protection of Bituminous Courses. No vehicular traffic of any kind shall be permitted on any lift until the mixture has hardened sufficiently not to be distorted unduly.

Any foreign material which may have accumulated on the surface of any course shall be removed before the course is rolled or before subsequent courses are placed thereon.

403.12 Method of Measurement. Hot asphalt concrete pavement will be measured in accordance with 401.16.

403.13 Basis of Payment. The accepted quantities of hot asphalt concrete pavement including base, binder, surface, wedge, and leveling courses will be paid for at the contract price per megagram (ton) for the bituminous mixture specified, complete in place.

Prime coat will be paid for in accordance with 408.10.

Tack coat will be paid for in accordance with 409.07.

Payment will be made under:

Pay Item	**Metric Pay Unit Symbol (English Pay Unit Symbol)**
Bituminous Base _____, _____ mixture LV, MV, or HV	Mg (TON)
Bituminous Binder _____, _____ mixture LV, MV, or HV	Mg (TON)
Bituminous Surface _____, _____ mixture LV, MV, or HV	Mg (TON)
Bituminous Base _____ HAC, _____ mixture LV, MV, or HV	Mg (TON)
Bituminous Binder _____ HAC, _____ mixture LV, MV, or HV	Mg (TON)
Bituminous Surface _____ HAC, _____ mixture LV, MV, or HV	Mg (TON)

If air cooled blast furnace slag is used in hot asphalt concrete or if steel slag is used in hot asphalt concrete surface, the pay quantity will be adjusted in accordance with 904.02(a).

If the mixture is not specified on the plans, or in the Schedule of Pay Items, the mixtures as set out herein may be used for the specified pay item, except as restricted in 403.04(b).

If bituminous binder over bituminous base is specified, bituminous binder 8 will be permitted as a substitute for the bituminous binder and bituminous base upon receipt of a written request. The request for the change shall be prepared in advance of the work. A computation will be made in order to obtain a unit price for the bituminous binder 8. The quantity and amount for bituminous binder 8 shall equal the sum of the contract quantities and amounts shown for bituminous base and bituminous binder. The unit price for bituminous binder 8 shall be equal to the sum of contract amounts divided by the sum of contract quantities. Payment for the bituminous binder 8 will be made at the unit price per megagram (ton) for bituminous binder 8. No payment will be made for additional work or costs which may result due to this change.

If the Schedule of Pay Items contains pay items for both hot asphalt concrete base and hot asphalt concrete binder, and the Contractor elects to substitute base material for binder material, the material used will be paid for at the contract unit price for hot asphalt concrete base or hot asphalt concrete binder, whichever is less.

SECTION 404—BITUMINOUS COATED AGGREGATE PAVEMENT

404.01 Description. This work shall consist of constructing one or more courses of plant mixed bituminous coated aggregate mixture on a prepared subgrade, subbase, or an existing surface used as a base, as shown or directed, compacted by rolling, and finished with a surface course as specified in accordance with these specifications and in reasonably close conformance with the established lines, grades, thicknesses, and typical cross sections shown on the plans or as directed.

The base course shall be mixture 2, 5, or 5d as specified. The binder course shall be mixture 8, 9, or 11 as specified. The surface course shall be one of the bituminous surfaces in accordance with 402 or 403, or a seal coat in accordance with 407, or a bituminous coated aggregate surface mixture 11, as specified. The composition limits for the specified base, binder, and surface 11 mixture are included in 404.02.

MATERIALS

404.02 Materials. The materials shall be in accordance with the following:

Bituminous Materials for Mixtures and for Patching	
Asphalt Emulsion, AE-60, AE-90	902.04
Petroleum Asphalt Cement AC-20, AC-10	902.01(g)
Petroleum Asphalt Cement AP-5, AP-4, AP-3	902.01(a)
Petroleum Asphalt Cement PG 64-22, PG 58-28	902.01(h)
Bituminous Materials for Prime Coat	
Asphalt Emulsion, AE-P	902.04
Cut-Back Asphalt, MC-70	902.03
Bituminous Materials for Tack Coat	
Asphalt Emulsion, AE-T	902.04
Cut-Back Asphalt, RC-70	902.03

Coarse Aggregates for Mixtures 904.02
For Base, Class A, B, C, or D
For Binder, Class A, B, or C
For Surface, Class A or B
Cover (Choke) Aggregate
Coarse Aggregate
Class A or B, Size No. 11 or 12 . . . . . 904.02
Fine Aggregate (natural sand or blast furnace slag sand), Size No. 23, 24 . . . . . 904.01

RC-70 may be used only during the months of November, December, January, February, and March.

The size of mixture and the grade of bituminous material shall be as specified. The bitumen proportions, by weight, will be fixed by the Engineer within the following limits; except when blast furnace slag is used as an alternate to natural aggregate, limits may be waived to permit adjustments to compensate for differences in specific gravity in accordance with 904.02(a).

Sieve Size	Composition Limits					
	Total Percent of Aggregates Passing Sieves Based on Total Weight of Aggregates					
	2	5	8	9	11	5D
63 mm (2 1/2 in.)	100					
50 mm (2 in.)	95-100					
37.5 mm (1 1/2 in.)		100				100
25.0 mm (1 in.)	0-25	85-100	100			80-99
19.0 mm (3/4 in.)	0-10	60-90	75-100	100		68-90
12.5 mm (1/2 in.)	0-7	30-65	40-75	65-90	100	54-76
9.5 mm (3/8 in.)		15-50	20-55	30-65	75-100	45-67
4.75 mm (No. 4)		0-20	0-20	0-20	10-35	30-50
2.36 mm (No. 8)		0-15	0-15	0-15	0-15	20-45
600 µm (No. 30)						7-28
75 µm (No. 200)	0-5	0-5	0-5	0-6	0-6	0-6
Minimum** Percent Crushed	95	95	95	95	95	95
Percent* of Bitumen	2.0-3.5	2.5-4.0	3.0-4.5	3.5-5.0	4.0-6.0	3.5-5.0

*Percent of bitumen shall be calculated on the basis of the total weight of the mixture exclusive of water or solvent. When slag is used, the bitumen content will be adjusted to compensate for the specific gravity and surface area.
**Minimum percent crushed shall be 40 when used in underdrain construction.

A portion of the mixture to be placed for wedge and leveling, approaches, or any areas involving feathering shall be 9 or 11 mixture as may be directed.

The aggregate shall be heated in a drier just prior to the mixing operation. It shall be sufficiently dry so that, when the specified amount of bituminous material is introduced, the aggregate uniformly coats and satisfactorily retains the required amount of bitumen during the hauling, spreading, rolling, and curing operations.

The temperature of the finished mixture at the time of discharge from the mixer shall be such that it produces a workable mixture when incorporated into the work. The mixture temperature shall be from 80þ C (180þ F) to 120þ C (250þ F) at time of discharge. The bituminous material shall enter the mixer at a temperature so that it thoroughly coats the aggregate, but the temperature shall not exceed 80þ C (180þ F) for asphalt emulsions, or 165þ C (325þ F) for petroleum asphalts.

CONSTRUCTION REQUIREMENTS

404.03 General Requirements. The construction requirements shall be in accordance with 401.06, 401.07, 401.08, 401.09, 401.10, 401.11, 401.12, 401.13, 401.14, and 401.15, and 402.05, 402.06, 402.07, 402.08, 402.09, 402.10, and 402.11, except as herein modified. Weather limitations shall be in accordance with 406.04.

404.04 Bituminous Mixing Plant. The bituminous mixing plant shall be in accordance with to 401.06, except screens will not be required if the specified gradation and uniformity can be maintained in the finished mixture.

404.05 Preparation of Subgrade or Base. This work shall be in accordance with applicable provisions of 403.06, except proof rolling will not be required unless otherwise provided.

404.06 Prime Coat. Application of the prime coat shall be in accordance with 408.

404.07 Tack Coat. The tack coat shall be in accordance with 409.

404.08 Spreading Mixture. Spreading of the mixture shall be in accordance with applicable provisions of 403.09.

404.09 Curing. Before rolling, all spread mixtures shall be allowed to cure sufficiently to prevent undue distortions under the roller wheels.

When a mixture is allowed to cure under traffic, the surface shall be maintained and any damaged areas shall be satisfactorily repaired.

404.10 Compacting. The final rolling shall be with a tandem roller. Compacting shall, in general, be in accordance with applicable provisions of 401.12. Just prior to final rolling open graded mixtures, a uniform application of 3 to 8 kg per m^2 (5 to 15 lb/sq yd) of cover aggregate shall be spread on the surface. The exact amount and size shall be as directed.

404.11 Protection of Bituminous Courses. Protection of the bituminous courses shall be in accordance with 403.11.

404.12 Surface Tolerances. Surface tolerances shall be in accordance with 401.15.

404.13 Surface Courses. Surface courses shall be constructed in accordance with 402, 403, 404, or 407, whichever is applicable.

404.14 Method of Measurement. Bituminous coated aggregate pavement will be measured in accordance with 401.16.

Cover aggregate will be measured by the megagram (ton).

404.15 Basis of Payment. The accepted quantities of bituminous coated aggregate pavement and cover aggregate will be paid for at the contract unit price per megagram (ton). Bituminous material will be paid for as set out below, complete in place.

Prime coat will be paid for in accordance with 408.10.

Tack coat will be paid for in accordance with 409.07.

Seal coat will be paid for in accordance with 407.10.

Hot mix surface course will be paid for in accordance with 402.13 or 403.13, whichever is applicable.

Payment will be made under:

Pay Item	Metric Pay Unit Symbol (English Pay Unit Symbol)
Bituminous Coated Aggregate Base, ____, _____ (size, LV, MV, or HV)	Mg (TON)
Bituminous Coated Aggregate Binder, ____, _____ (size, LV, MV, or HV)	Mg (TON)
Bituminous Coated Aggregate Surface, ____, _____ (size, LV, MV, or HV)	Mg (TON)
Cover Aggregate	Mg (TON)

If steel slag is used in bituminous coated aggregate surface, the pay quantity will be adjusted in accordance with 904.02(a).

SECTION 405—ROAD MIX BITUMINOUS PAVEMENT

405.01 Description. This work shall consist of constructing one or more courses of road mix bituminous pavement on a prepared subgrade or previously constructed course, mixed on the road, compacted by rolling, and finished with a surface course, as specified, in accordance with these specifications and in reasonably close conformance with the lines, grades, and typical cross sections shown on the plans or as directed.

The surface course shall be one of the bituminous surfaces in accordance with 402, 403, or 406, or a seal coat in accordance with 407, as specified.

Substitution of cold mixed bituminous base or binder in accordance with 406 in lieu of road mix bituminous base or binder may be permitted.

MATERIALS

405.02 Bituminous Material. The bituminous material shall be in accordance with the following:

Bituminous Materials for Mixture	
Asphalt Emulsion, AE-90, AE-150	902.04
Cut-Back Asphalt, RC-800, RCA-800	902.03
Bituminous Materials for Prime Coat	
Asphalt Emulsion, AE-P	902.04
Cut-Back Asphalt, MC-70	902.03
Bituminous Materials for Tack Coat	
Asphalt Emulsion, AE-T	902.04
Cut-Back Asphalt, RC-70	902.03

RC-70, RC-800, and RCA-800 may be used only during the months of November, December, January, February, and March.

Composition of mixtures shall be within the limits specified in 404.02.

405.03 Aggregates. Aggregates shall meet the requirements for the grading size and type specified. The aggregate will be accepted immediately preceding addition of bituminous material to the mix. This acceptance will be based on periodic samples of the windrow after all aggregates have been blended for each layer. Coarse aggregates shall be in accordance with the following:

For Base Mixtures, class A, B, C, or D, size No. 5	904.02
For Binder Mixtures, class A, B, or C, size No. 8, 9	904.02

CONSTRUCTION REQUIREMENTS

405.04 Weather Limitations. Weather conditions during the placement of mixtures shall be in accordance with 406.04.

405.05 Equipment. The equipment used shall include scarifying, mixing, spreading, finishing, and compacting equipment; a bituminous distributor; and equipment for heating bituminous material.

The distributor shall be so designed, equipped, maintained, and operated that bituminous material at even heat may be applied uniformly on variable widths of surface up to 4.6 m (15 ft). Readily determined and controlled rates of from 0.23 to 9.1 L/m^2 (0.05 to 2.0 gal. per sq yd) shall be maintained with uniform pressure. There shall be an allowable variation from any specified rate not to exceed 0.09 L/m^2 (0.02 gal. per sq yd). Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

Traveling or stationary mixing plants or other equipment of proven performance may be used in lieu of the specified equipment if approved.

Rollers shall be in accordance with 401.09.

405.06 Preparation of Base. Before spreading materials for road mixing, the surface of the base, or road surface on which the road mix is to be placed, shall be conditioned in accordance with 401.10. If the road mix bituminous base is to be placed on a loose macadam base or a granular subbase, the area shall be primed in accordance with 408.

If the course is placed on an existing bituminous course or rigid base, or if the bituminous film has become partially removed on the previously laid course so that the subsequent course will not adhere, then a tack coat of from 0.23 to 0.68 L/m^2 (0.05 to 0.15 gal. per sq yd) of bituminous material in accordance with 409 shall be placed as directed.

405.07 Placing Aggregate. The aggregate shall be spread without segregation with spreader boxes or other approved devices. No materials shall be dumped in piles and spread therefrom.

After the aggregate has been spread, it shall be shaped to the required cross section and be free from irregularities.

405.08 Application of Bituminous Material. The distributor shall be in accordance with 405.05. Spray bars spanning the entire width of the surface are preferred. The bituminous material shall be uniformly applied to the aggregate and spread in accordance with 405.07, in one or more applications as directed. The exact amount will be as directed within the prescribed limits as set out elsewhere for the material used. The application temperature of the bituminous material shall be such that a suitable and workable mixture is obtained, but it shall not exceed those shown in 903.10 for the respective materials.

The moisture condition of the aggregate shall be such that the aggregate retains the required amount of bitumen as a uniform coating during mixing, shaping, and compacting operations.

405.09 Mixing. Immediately after any application of bituminous material, the aggregate and bituminous material shall be road mixed for its entire depth. Mixing shall be done with blade graders, multiple blade maintainers, or other mixing devices if approved. Mixing shall be such that all particles are coated thoroughly and uniformly and segregation avoided. After mixing, the mixture shall be spread evenly over the surface, true to grade and crown.

If the initial application does not sufficiently coat the aggregate, it shall receive an additional application sufficient to satisfactorily coat the aggregate and then be mixed and spread as before. If the edges appear to be too dry, they shall receive an additional

light application as needed. If directed, the mixture shall be maintained in place by dragging with a drag or planer, the base of which is no less than 5.5 m (18 ft), until a uniform surface results.

In lieu of road mixing as above prescribed, any machine method of mixing, or mixing and spreading, may be used if approved in writing before the work is started. Original approval shall not necessarily constitute continued approval if the machine mixing as used does not give satisfactory results, in which case the method described above shall be used.

If a machine mixing or a machine mixing and spreading device is used, the device shall be designed as a unit and be capable of producing a uniform and well coated mixture.

If machine mixing is used, the Engineer may direct that a heavier grade of bituminous material be used than would have been used for other methods.

405.10 Spreading, Compacting, and Finishing. After mixing, the mixture shall be spread over the surface true to line, grade, and crown, using an approved spreading device.

After the material is spread, the surface shall be rolled. Rolling shall be parallel to the road centerline and shall commence at the outer edges of the road, overlapping the shoulders, progressing toward the center, overlapping on successive passes by at least 1/2 of the width of the roller wheel. On super-elevated curves, rolling shall progress from the lower to the upper edge. Each pass shall terminate at least 0.9 m (3 ft) in advance, or to the rear of the end of the preceding pass. During the compaction, the surface shall be dragged or bladed as necessary to fill ruts and to remove incipient corrugations or other irregularities. Rolling shall continue until the surfacing is of uniform texture and satisfactory compaction has been obtained. Initial rolling shall be performed with a pneumatic tire roller and final rolling with a 3 wheel or tandem type steel wheel roller. Rolling shall be discontinued whenever it begins to produce excessive pulverizing of the aggregate or displacement of the mixture.

405.11 Surface Tolerances. The surface of road mix bituminous courses shall be in accordance with 401.15.

Depressions exceeding the specified tolerance shall be corrected by patching with a mixture of size No. 11 aggregate, unless another size is directed, using the same proportions of bituminous material as used in the surface mixture. This patching mixture may be mixed in accordance with 620.03 and 620.04. If directed, the surface under the patches shall receive a tack coat from 0.23 to 0.45 liters per m^2 (0.05 to 0.10 gal. per sq yd) of the same material used in the patching mixture. The mixture shall be carefully spread over the area to be patched, using handraking if necessary. After spreading, patches shall be rolled and made to conform to the surrounding surface.

Any areas which develop an excess of bitumen shall be removed and replaced with proper materials.

After the surface has been checked and corrected, if needed, it shall be allowed to cure until it becomes firm and stable before the following course is placed thereon. The course shall be maintained during the curing period.

Any foreign material which may have collected on any unfinished surface shall be removed before the distributor, roller, or any traffic passes over the surface.

405.12 Surface Courses. Surface courses shall be constructed in accordance with 402, 403, 406, or 407, whichever is applicable.

405.13 Method of Measurement. Aggregate and bituminous material for road mix bituminous pavement will be measured by the megagram (ton) in accordance with 109.01.

405.14 Basis of Payment. The accepted quantities of road mix bituminous pavement will be paid for at the contract price per megagram (ton) for aggregates, including that used in patching, and per megagram (ton) for bituminous material applied, including that used in patching, prime coat, and tack coat, complete in place.

Cold mixed bituminous base or binder, furnished in lieu of road mixed bituminous base or binder, will be paid for in accordance with 406.21.

Surface course will be paid for in accordance with 402.13, 403.13, 406.21, or 407.10, whichever is applicable.

Payment will be made under:

Pay Item	Metric Pay Unit Symbol (English Pay Unit Symbol)
Road Mix Bituminous Pavement Aggregate, _____ LV, MV, or HV	Mg (TON)
Road Mix Bituminous Pavement Material,	Mg (TON)

SECTION 406—COLD MIXED BITUMINOUS PAVEMENT

406.01 Description. This work shall consist of the construction of one or more courses of cold mixed bituminous coated aggregate base, open or dense graded, or binder produced in a stationary plant for immediate use or to be stockpiled. The mixture shall be laid cold on a prepared subgrade, or previously constructed course, compacted by rolling, and finished with a surface course, as specified, in accordance with these specifications and in reasonably close conformance with the lines, grades, amounts, and typical cross sections shown on the plans or as directed.

The base course shall be a cold mixture 2, 5, or 5D as specified. The binder course shall be a cold mixture 8, 9, or 11 as specified. The surface course shall be one of the bituminous surface in accordance with 402 or 403, or a seal coat in accordance

with 407, or a bituminous coated aggregate surface mixture 11 as specified, or a cold mixed natural sand surface in accordance with composition limits of 24 sand in 904.01(g). The composition limits for the specified base, binder, and surface 11 mixture are included in 404.02.

MATERIALS

406.02 Materials. Materials shall be in accordance with the following:

Bituminous Material for Mixtures	
For Immediate Use, Asphalt Emulsion AE-150, AE-90	902.04
For Stockpiling, Asphalt Emulsion AE-150	902.04
Bituminous Materials for Prime Coat	
Asphalt Emulsion, AE-P	902.04
Cut-Back Asphalt, MC-70	902.03
Bituminous Materials for Tack Coat	
Asphalt Emulsion, AE-T	902.04
Cut-Back Asphalt, RC-70	902.03
Coarse Aggregates	
For Base Mixtures (open graded), Class A, B, C, or D	904.02
For Binder Mixtures, Class A, B, or C	904.02
For Surface Mixtures, Class A or B	904.02
Natural Sand Surface	904.01

All coarse aggregate shall be 95 percent crushed. RC-70 may be used only during the months of November, December, January, February, and March.

CONSTRUCTION REQUIREMENTS

406.03 General Requirements. The mixture may be used directly from the pugmill or stockpiled for future use, except mixtures made with slag aggregate shall not be stockpiled.

406.04 Weather Limitations. Bituminous mixtures shall not be placed when the air temperature is below 4þ C (40þ F); when the surface on which they are to be placed is wet; nor when other conditions are deemed unsuitable.

406.05 Bituminous Mixing Plant. The mixing plant shall be of sufficient capacity and coordination to adequately handle the proposed bituminous construction. The mixing unit shall be a twin shaft pugmill or other approved mixer, including the drum type, capable of producing a constant uniform mixture. The outlet of the mixer unit shall be such that it prevents segregation of the material when discharged.

406.06 Synchronization of Aggregate and Bituminous Feed. Satisfactory means, under control of the Engineer, shall be provided in order to assure positive interlocking control between the flow of the aggregate from the bin and the bituminous

material from the meter or other proportioning source. A feed system using electric motors will be considered interlocking if these motors are powered from the same line. A means shall be provided to obtain samples of aggregate and bituminous material for determination of the percentage of each being delivered to the mixer. Accurate equipment for weighing the material shall be included.

406.07 Preparation of Mixtures. The size of the aggregate and the grade of bituminous materials shall be as specified. The bitumen proportions and gradations will be fixed by the Engineer within the applicable limits of 404.02. It may be directed that a portion of the mixture to be placed as wedge and leveling or for areas involving feathering be produced using size No. 9 or No. 11 aggregate. Size No. 5D may be produced as a one or 2 component material.

The moisture condition of the aggregate shall be such that the aggregate uniformly coats and satisfactorily retains the required amount of bitumen during the stockpiling, hauling, and spreading operations. Mixtures which are to be placed in a stockpile shall be produced at a temperature which will permit easy removal from the stockpile, and in no case shall the temperature exceed 80þ C (180þ F).

406.08 Hauling Equipment. Hauling equipment shall be in accordance with 401.07.

406.09 Bituminous Pavers. Pavers shall be in accordance with the applicable provisions of 401.08.

406.10 Rollers. Rollers shall be in accordance with the applicable provisions of 401.09.

406.11 Preparation of Subgrade or Base. Preparation of the subgrade or base shall be in accordance with 404.05.

406.12 Prime Coat. If the previously constructed course is granular, and a prime coat is required, it shall be in accordance with 408.

406.13 Tack Coat. The tack coat shall be in accordance with 409.

406.14 Spreading Mixture. The mixture shall be spread with a bituminous paver. The depth of any lift shall not exceed 3 times the maximum dimension of the size aggregate being used. The size is to be determined by actual screen analysis. If the required compacted thickness of the section exceeds this, it shall be constructed in 2 or more lifts as directed. All non-uniform areas shall be removed and replaced with properly coated aggregate of the specified gradation. In places inaccessible to mechanical spreading, or in other approved areas, hand spreading will be permitted. Mixtures placed in trenches, which are too narrow to accommodate the regular spreading and compacting equipment, shall be placed with approved mechanical spreading and finishing machines, and compacted with trench rollers in accordance with 401.09(f) unless other equipment is approved.

406.15 Curing. Curing shall be in accordance with the applicable requirements of 404.09.

406.16 Compacting. Compacting shall be in accordance with the applicable requirements of 401.12. Before compaction, temporary earth shoulders shall be built up to the elevation of the top of the layer being placed in order to provide lateral support and to keep the materials from being displaced beyond the limits of the specified width while being compacted. The inside edge of these shoulders shall be constructed as nearly straight and vertical as practicable. During initial compaction of the mixture, at least 300 mm (12 in.) in width of the shoulder material shall be compacted simultaneously with the adjacent mixture. Other satisfactory means of confining the mixture within the required limits may be approved.

406.17 Protection of Bituminous Courses. Protection of the courses shall be in accordance with 403.11.

406.18 Surface Tolerances. The surface of cold mixed bituminous pavement courses shall be in accordance with 401.15.

406.19 Surface Course. Surface courses shall be constructed in accordance with 402, 403, or 407, whichever is applicable.

406.20 Method of Measurement. Cold mixed bituminous pavement will be measured in accordance with 401.16.

406.21 Basis of Payment. The accepted quantities of cold mixed bituminous pavement of the type specified will be paid for at the contract unit price per megagram (ton) for the bituminous mixture and by the megagram (ton) for the bituminous material, when so specified, complete in place.

Prime coat will be paid for in accordance with 408.10.

Tack coat will be paid for in accordance with 409.07.

Surface course, other than provided for above, will be paid for in accordance with 402.13, 403.13, 407.09, or 407.10, whichever is applicable.

Payment will be made under:

Pay Item	Metric Pay Unit Symbol (English Pay Unit Symbol
Bituminous Base ____, Cold Mixed size	Mg (TON)
Bituminous Binder ____, Cold Mixed size	Mg (TON)
Bituminous Surface ____, Cold Mixed size	Mg (TON)

SECTION 407—SEAL COAT

407.01 Description. This work shall consist of one or more applications of bituminous material, each followed by an application of cover aggregate in accordance with these specifications and in reasonably close conformance with the lines shown on the plans or as directed.

MATERIALS

407.02 Bituminous Material. The type and grade of bituminous material shall be one of the following, or as specified or directed, and meet referenced requirements.

Bituminous Material for Prime Coat	
Asphalt Emulsion, AE-P	902.04
Cut-Back Asphalt, MC-70	902.03
Bituminous Materials for Seal Coat	
Asphalt Emulsion, RS-2, AE-90, AE-150	902.04
Cut-Back Asphalt, RC-800, RC-3000	902.03
Bituminous Material for Tack Coat	
Asphalt Emulsion, AE-T	902.04
Cut-Back Asphalt, RC-70	902.03

Cut-back asphalt RC-70, RC-800, and RC-3000 may be used only during the months of November, December, January, February, and March.

407.03 Cover Aggregate. Aggregate shall be in accordance with the following requirements, except when slag is used as an alternate to natural aggregate, adjustments to compensate for differences in specific gravity, in accordance with 904.02(a), shall be made.

Coarse Aggregates Class A or B,	
Size No. 8, 9, 11, or 12	904.02
Fine Aggregate (natural sand only),	
Size No. 24	904.01

SEAL TYPES

TYPE	APPLICATION	COVER AGGREGATE SIZE NO.	RATES OF APPLICATION PER SQUARE METER (SQUARE YARD) AGGREGATE kg (lb)	BITUMINOUS MATERIAL LITER (GALLON) AT 16þC (60þF)
1*	Single	23,24	5.4-6.8 (12-15)	0.45-0.61 (0.12-0.16)
2	Single	12	6.4-7.7 (14-17)	1.09-1.25 (0.29-0.33)
3	Single	11	7.3-9.1 (16-20)	1.36-1.51 (0.36-0.40)
4	Single	9	12.7-14.5 (28-32)	2.38-2.57 (0.63-0.68)
5	Double	a. 11	7.3-9.1 (16-20)	1.36-1.51 (0.36-0.40)
		b. 12	7.3-8.6 (16-19)	1.25-1.40 (0.33-0.37)
6	Double	a. 9	12.7-14.5 (28-32)	2.38-2.57 (0.63-0.68)
		b. 11	8.2-10.0 (18-22)	1.55-1.74 (0.41-0.46)
7	Double	a. 8	12.7-14.5 (28-32)	2.38-2.57 (0.63-0.68)
		b. 11	8.2-10.0 (18-22)	1.55-1.74 (0.41-0.46)

*Only AE-90 or AE-150 shall be used for Seal Coat, Type 1.

The application temperature for RS-2 shall be 49 to 60þ C (120þ F to 140þ F), for RC800 shall be 110 to 121þ C (230þ F to 250þ F), and for RC-3000 shall be 121 to 135þ C (250þ F to 275þ F).

CONSTRUCTION REQUIREMENTS

407.04 Weather Limitations. Bituminous material shall not be applied on a wet surface, or when other weather conditions would prevent the proper construction of seal coats. Seal coats shall not be placed when the air or base temperature is below 4þ C (40þ F). If seal coats are placed when the air or base temperature is between 4þ C

(40þ F) and 16þ C (60þ F), the cover aggregate shall be heated to between 49þ C (120þ F) and 66þ C (150þ F) if emulsified asphalt is used as the bituminous material, or to between 66þ C (150þ F) and 93þ C (200þ F) if cutback asphalt is used as the bituminous material.

407.05 Equipment. The following equipment or its equivalent will be required for a seal coat:

(a) Equipment for heating and applying bituminous material in accordance with 405.05.

(b) A rotary power broom.

(c) A minimum of one pneumatic tire roller. If the rate of placement of bituminous material and cover aggregate exceeds 3345 m^2 (4,000 sq yd) per hour, a second pneumatic tire roller will be required. The pneumatic tire rollers shall weigh a minimum of 8 Mg (9 t) and shall have tires of 7.50 by 15 minimum size. The rollers shall be capable of exerting a uniform, average contact pressure from 345 kPa to 621 kPa (50 to 90 lb/sq in.)). The rollers shall not be operated at speeds which will displace the cover aggregate from the bituminous material.

(d) One aggregate spreader which is equipped with positive controls so that the required amount of aggregate is deposited uniformly over the full width of the bituminous material.

407.06 Preparation of Surface. Surfaces to be sealed shall be brought to proper crown and grade and thoroughly compacted. Bituminous material shall not be spread until the surface has been cleaned as required and the section to be sealed has been approved.

If so specified or directed, non-bituminous surfaces to be sealed, except rigid types, shall be primed to bind the upper portion; to provide a surface to which the seal coat adheres; and to prevent subsequent applications from being absorbed excessively. This may also apply to old bituminous surfaces. Priming shall be in accordance with the applicable provisions of 408.

An open texture bituminous surface shall be treated to seal surface voids and be in such condition that the seal coat application of bituminous material forms a uniform film to embed the cover aggregate satisfactorily. This shall be accomplished by applying a tack coat at the rate of 0.23 to 1.13 L/m^2 (0.05 to 0.25 gal. per sq yd), the exact amount to be as directed. This shall be followed by sufficient aggregate to fill existing surface voids. Depending on the size of the aggregate, 3 to 8 kg/m^2 (5 to 15 lb/sq yd) shall be applied. The aggregate shall be broomed immediately or dragged with an approved drag, and rolled with a pneumatic tire roller. This brooming or dragging, and rolling shall be repeated as directed. Any excess aggregate shall be swept from the surface prior to the application of the bituminous seal coat.

407.07 Applying Bituminous Material. Bituminous material shall be applied by means of a pressure distributor in a uniform continuous spread over the section to be treated and within the temperature range specified. The quantity of bituminous material to be used per square meter (square yard) shall be as directed. The distributor shall be moving forward at proper application speed at the time the spray bar is opened. Any skipped areas or deficiencies shall be corrected. Junctions of spreads shall be carefully made to assure a smooth riding surface.

The bituminous material shall not be spread for a greater distance than that which can be covered with the cover aggregate that is in trucks at the site. It shall never be spread more than 150 m (500 linear feet) ahead of the aggregate spreader at any time.

The spread of the bituminous material shall be no wider than the width covered by the cover aggregate from the spreading device. Under no circumstances shall operations proceed in such manner that bituminous material is allowed to chill, set up, dry, or otherwise impair retention of the cover coat.

The distributor, when not spreading, shall be parked so that the spray bar or mechanism does not drip bituminous materials on the surface of the traveled way.

407.08 Application of Cover Aggregate. Immediately following the application of the bituminous material, cover aggregate shall be spread in quantities as directed. Spreading shall be accomplished in such a manner that the tires of the trucks or aggregate spreader at no time contact the uncovered and newly applied bituminous material.

If directed, the cover aggregate shall be moistened with water to eliminate or reduce the dust coating of the aggregate. Moistening shall be done the day before the use of the aggregate.

Immediately after the cover aggregate is spread, any deficient areas shall be covered with additional material. Rolling shall begin immediately behind the aggregate spreader and shall consist of at least 3 complete roller coverages. Rolling shall be completed within 30 minutes after the cover aggregate is applied.

Unless otherwise approved, excess cover aggregate shall be removed from the pavement surface by light brooming on the day following placement of the seal coat. The brooming shall not displace the imbedded cover aggregate.

Neither the tack coat nor the seal coat shall be opened to traffic until the bituminous material has cured or set sufficiently to hold the cover aggregate without displacement. Protection may consist of restricting traffic entirely or controlling its speed as approved.

407.09 Method of Measurement. Bituminous material and cover aggregate will be measured by the megagram (ton). Seal coat will be measured by the square meter (square yard).

If measurement is made by the square meter (square yard), the quantity for each day's placement will be the least of the following:

(a) The measured square meters (square yards) within the specified limits.

(b) The calculated square meters (square yards) based on the amount of aggregate used, divided by the minimum amount of aggregate per square meter (square yard) specified in 407.03.

(c) The calculated square meters (square yards) based on the amount of bituminous material used, divided by the minimum amount of bituminous material per square meter (square yard) specified in 407.03.

407.10 Basis of Payment. The accepted quantities of bituminous material and cover aggregate will be paid for at the contract price per megagram (ton). Seal coat will be paid for at the contract price per square meter (square yard) complete in place. If steel slag is used as a cover aggregate, and payment will be made per megagram (ton), the pay quantity will be adjusted in accordance with 904.02(a).

Prime coat will be paid for in accordance with 408.10.

Tack coat will be paid for in accordance with 409.07.

If seal coat is paid for by the square meter (square yard) and if such is ordered in writing, bituminous material in excess of the limits set out in 407.03 will be paid for at the Contractor's invoice price, plus 20 percent.

Payment will be made under:

Pay Item	Metric Pay Unit Symbol (English Pay Unit Symbol
Bituminous Material for Seal Coat	Mg (TON)
Cover Aggregate	Mg (TON)
Seal Coat, ____ type	m2 (SYS)

SECTION 408—PRIME COAT

408.01 Description. This work shall consist of preparing and treating an existing surface with bituminous material and cover aggregate, if required, in accordance with these specifications and in reasonably close conformance with the lines shown on the plans or as directed.

MATERIALS

408.02 Bituminous Material. The type and grade of bituminous material shall be in accordance with the following:

Asphalt Emulsion, AE-P or AE-PL 902.04
Cut-Back Asphalt, MC-70 . . . . . 902.03

408.03 Cover Aggregate. Aggregate shall be in accordance with the following:

Coarse Aggregate, Class A or B, Size No. 12 . . . . . 904.02
Fine Aggregate, Size No. 23 or 24 . . . . . 904.01

CONSTRUCTION REQUIREMENTS

408.04 Weather Limitations. Bituminous material shall not be applied on a wet surface when the temperature is below 16þ C (60þ F) unless otherwise authorized in writing nor when weather conditions would prevent the proper construction of the prime coat.

408.05 Equipment. Equipment shall be provided for heating and applying the bituminous material, and for applying cover aggregate. The equipment shall be in accordance with 405.05.

408.06 Preparation of Surface. The surface to be primed shall be shaped to the required grade and section; shall be free from all ruts, corrugations, segregated material, or other irregularities; and shall be uniformly compacted.

Delays in priming shall necessitate reprocessing or reshaping to provide a smooth compacted surface.

408.07 Application of Bituminous Material. Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform continuous spread. When traffic is maintained, not more than 1/2 of the width of the section shall be treated in one application. The application of bituminous material at the junctions of spreads shall not be in excess of the specified amount. Excess bituminous material shall be squeegeed from the surface. Skipped areas, or deficiencies shall be corrected. Building paper shall be placed over the end of the previous applications and the joining application shall start on the building paper. Building paper used shall be removed and disposed of satisfactorily.

When traffic is maintained, one way traffic shall be permitted on the untreated portion of the roadbed. As soon as the bituminous material has been absorbed by the surface and does not pick up, traffic shall be transferred to the treated portion and the remaining width of the section shall be primed.

The quantities, rate of application, temperatures, and areas to be treated shall be approved before application of the prime coat.

The rate of application may vary from 1.1 to 3.6 L/m^2 (0.25 to 0.80 gal. per sq yd) depending on the condition of the surface and the kind, gradation, and amount of loose aggregate. No course shall be placed on a primed surface until the bituminous material has penetrated and the surface is dry, unless otherwise permitted.

408.08 Application of Cover Aggregate. If, after the application of the prime coat, the bituminous material fails to penetrate and leave a dry surface within a reasonable time and the roadway must be used by traffic, cover aggregate shall be spread in the amounts required to absorb any excess bituminous material.

408.09 Method of Measurement. Bituminous material for prime coat will be measured by the megagram (ton), or by the square meter (square yard). Cover aggregate will be measured by the megagram (ton) in accordance with 109.01.

70

408.10 Basis of Payment. The accepted quantities of prime coat will be paid for at the contract unit price per megagram (ton), or per square meter (square yard) for bituminous material for prime coat. Cover aggregate will be paid for at the contract unit price per megagram (ton), complete in place.

Payment will be made under:

Pay Item	Metric Pay Unit Symbol (English Pay Unit Symbol
80 Bituminous Material for Prime Coat	Mg (TON) m2 (SYS)
Cover Aggregate	Mg (TON)

SECTION 409—TACK COAT

409.01 Description. This work shall consist of preparing and treating an existing bituminous or concrete surface with bituminous material in accordance with these specifications and in reasonably close conformance with the lines shown on the plans or as directed.

MATERIALS

10 **409.02 Bituminous Material.** The type and grade of bituminous material shall be in accordance with the following:

Asphalt Emulsion, AE-T	902.04
Cut-Back Asphalt, RC-70	902.03

RC-70 may be used only during the months of November, December, January, February, and March.

CONSTRUCTION REQUIREMENTS

20

409.03 Equipment. Equipment shall be provided for heating and applying the bituminous material. This equipment shall be in accordance with 405.05.

409.04 Preparation of Surface to be Treated. The existing surface shall be patched and cleaned, and shall be free of irregularities to provide a reasonably smooth and uniform surface to receive the treatment. Unstable corrugated areas shall be removed

and replaced with suitable patching materials. Payment for the patching will be made at the contract unit price for the various items used unless a reconditioning item is included in the contract. The edges of existing pavements, which are to be adjacent to new pavement, shall be cleaned to permit adhesion of the bituminous materials.

409.05 Application of Bituminous Material. The bituminous material shall be uniformly applied with a pressure distributor at the rate of from 0.14 to 0.36 L/m^2 (0.03 to 0.08 gal. per sq yd), or as otherwise specified or directed.

The tack coat shall be applied in such manner as to offer the least inconvenience to traffic and to permit one way traffic without pickup or tracking of the bituminous material.

Tack coat shall not be applied during wet or cold weather, after sunset, or to a wet surface. The quantity, rate of application, temperature, and areas to be treated shall be approved prior to application. The tack coat may be mopped, broomed, or squeegeed to facilitate curing and obtain a more even distribution.

409.06 Method of Measurement. Bituminous material for tack coat will be measured by the megagram (ton) in accordance with 109.01(d), or by the square meter (square yard).

409.07 Basis of Payment. The accepted quantities of tack coat will be paid for at the contract unit price per megagram (ton), or per square meter (square yard) for bituminous material for tack coat, complete in place.

Payment will be made under:

Pay Item	Metric Pay Unit Symbol (English Pay Unit Symbol)
Bituminous Material for Tack Coat	Mg (TON) m2 (SYS)

SECTION 410—DUST PALATIVE

410.01 Description. This work shall consist of preparing and treating an existing aggregate surface with bituminous material in accordance with these specifications and in reasonably close conformance with the lines shown on the plans or as directed.

MATERIALS

410.02 Bituminous Material. The type and grade of bituminous material shall be in accordance with the following:

Asphalt Emulsion, AE-PL 902.04

CONSTRUCTION REQUIREMENTS

410.03 Weather Limitations. Bituminous material shall not be applied on a wet surface; when the temperature is below 10þ C (50þ F), unless otherwise authorized in writing; nor when other conditions are deemed unsuitable.

410.04 Equipment. A distributor in accordance with 405.05 shall be provided.

410.05 Preparation of Surface. The surface to be treated shall be shaped to the required grade and section; shall be free from all ruts, corrugations, segregated material, or other irregularities; and shall be uniformly compacted.

410.06 Application of Bituminous Material. Bituminous material shall be applied by means of a distributor in a uniform continuous spread to the width of the section to be treated. When traffic is maintained, approximately 1/2 of the width of the section shall be treated in one application. The application of bituminous material at the junctions of spreads shall not be in excess of the specified amount. Excess bituminous materials shall be squeegeed from the surface. Skipped areas or deficiencies shall be corrected.

When traffic is maintained, one way traffic shall be permitted on the untreated portion of the roadbed. After the bituminous material has been absorbed by the surface and will not pick up, traffic shall be transferred to the treated portion and the remaining width of the section shall be treated.

The rate of application shall be from 1.2 to 4.5 L/m^2 (0.25 to 1.00 gal. per sq yd) as directed. No course shall be placed on a treated surface until the bituminous material has penetrated and the surface is dry, unless otherwise permitted.

410.07 Method of Measurement. Bituminous material for dust palative will be measured by the megagram (ton) in accordance with 109.01(d).

410.08 Basis of Payment. The accepted quantities of this work will be paid for at the contract unit price per megagram (ton) for bituminous material for dust palative, complete in place.

Payment will be made under:

Pay Item	**Metric Pay Unit Symbol (English Pay Unit Symbol**
Bituminous Material for Dust Palative	Mg (TON)